UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

Memorandum

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SUBJECT: Initial Apple Benefits Assessment for Azinphos-methyl and Phosmet

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Summary of Analysis

Azinphos-methyl (AZM) and phosmet are critical pest management inputs for US apple growers. AZM and phosmet are currently used on approximately 78 percent and 24 percent, respectively, of the estimated 464,500 bearing acres of apples in the US Geographically, the Biological and Economic Analysis Division (BEAD) has traditionally assessed US apple production in five regions: Pacific Northwest (WA, OR, ID), Pacific Southwest (CA, AZ), North Central (MI, OH), New England (CT, ME, MA, NH, NJ, NY, RI, VT), and Appalachian/Southern (DE, GA, MD, NC, PA, SC, TN, VA, WV). States were grouped regionally in this way based on similarities in climatic conditions, production practices, and pests. Other states not included in these regions commercially produce apples, but they collectively represent less than 9 percent of the bearing acreage and less than 4 percent of production. However, for the purpose of this analysis, BEAD has aggregated the five distinct regions into two, the West (Pacific Northwest and Pacific Southwest) and East (North Central, New England and Appalachian/Southern). Apple production and value of production statistics for the US and the East and West Regions can be found in Table 1 and usage of AZM and phosmet can be found in Table 2.

Table 1. Apple Production and the Value of Production in the US and the East and West Regions[1]

US/Region	Bearing Acreage[2] (acres)	Production[2] (million pounds)	Percent of US Production	Percent of Region Production	Value of Production ($1,000)
US	464,500	10,605	–	–	$1,434,394
East Region[3]	203,900	3,611	34%	--	$423,524
West Region[4]	220,600	6,611	62%	--	$932,456

1. Source: USDA/NASS Noncitrus Fruits and Nuts 2000 Preliminary Summary.
2. Totals in column do not sum because all states that commercially produce apples are not represented.
3. East Region States include MI, OH, CT, ME, MA, NH, NJ, NY, RI, VT, DE, GA, MD, NC, PA, SC, TN, VA, and WV.
4. West Region States include WA, OR, ID, CA, and AZ

Table 2. Usage of Azinphos-methyl and Phosmet on US, East Region and West Region Apples [1]

US/Region	Percent of Crop Treated	Base Acres Treated [2] (1000 acres)	Rates (lbs. ai/Acre)	Average # of Applications/ Yr.	Total Pounds Applied (1000 lbs)
Azinphos-methyl Usage					
US	78%	362	0.7	3	636
East Region [3]	80%	162	0.5 - 0.7	3	236
West Region [4]	76%	168	1.0	3	400
Phosmet Usage					
US	24%	112	1.4	2	267
East Region [3]	41%	84	1.0 - 1.3	2	188
West Region [4]	10%	23	2.0 - 2.3	2	78

1. Source: USDA/NASS Fruit and Nut Chemical Use, 1997 and 1999.
2. Base acres treated calculated using percent of crop treated estimates and bearing acreage from Table 1.

3. East Region States include MI, OH, CT, ME, MA, NH, NJ, NY, RI, VT, DE, GA, MD, NC, PA, SC, TN, VA, and WV.
4. West Region States include WA, OR, ID, CA, and AZ

BEAD evaluated four (4) hypothetical mitigation scenarios with the aim at assessing the individual benefits of the use of AZM and phosmet and the impact of altering the REIs for these two chemicals. These scenarios serve as the basis for this assessment:

- Scenario 1 - Azinphos-methyl REI >14 days, and phosmet REI less than or equal to 3 days. Azinphos-methyl would no longer be used by growers.
- Scenario 2 - Azinphos-methyl REI equal to 14 days, and phosmet REI >3 days. Phosmet would no longer be used by growers.
- Scenario 3 - Azinphos-methyl REI >14 days, and phosmet REI >3 days. Both azinphos-methyl and phosmet would no longer be used by growers.
- Scenario 4 - One application of azinphos-methyl at an REI equal to 14 days, and phosmet REI less than or equal to 3 days.

The impacts associated with the scenarios assessed are presented as changes in net revenues at the grower level and regional level and also aggregated to a national level impact estimate. The quantitative impacts presented are the result of substituting alternate pest control methods for applications of either AZM or phosmet or for both active ingredients and because of estimated yield and quality changes in harvested apples. These changes are estimated to occur for several reasons: 1) reduced pest control efficacy or difficulty in timing pest control applications before pest damage occurs; 2) interruptions in critical cultural activities such as hand thinning, summer pruning, tree training, placement of pheromone mating disruption ties and hand harvesting; and 3) applications of additional insecticides and acaracides to control expected pest outbreaks. Impacts that we were unable to quantify for this assessment are discussed qualitatively. Brief examples of these types of impacts are provided after the summary of the estimated quantitative impacts of the four hypothetical scenarios in the following table.

Table 3. Impacts Summary

<table>
<tr><th>Scenario</th><th>Region</th><th>Grower Level Impact</th><th>Region Level Impact</th><th>National Level Impact</th></tr>
<tr><td rowspan="2">1
REIs:
AZM: >14 days
(AZM not used)

Phosmet: =/<3 days</td><td>East</td><td>Net Loss:
$115/A</td><td>Net Loss:
$18.85 million</td><td rowspan="2">Net Loss:
$49.25 million to $84.65 million</td></tr>
<tr><td>West</td><td>Net Loss:
$205/A to $393/A</td><td>Net Loss:
$34.4 million to $65.8 million</td></tr>
<tr><td rowspan="2">2
REIs:
AZM: =/<14 days

Phosmet: >3 days
(Phos not used)</td><td>East</td><td>Net Loss:
$52/A</td><td>Net Loss:
$4.6 million</td><td rowspan="2">Net Loss:
$6.7 million to $9.5 million</td></tr>
<tr><td>West</td><td>Net Loss:
$86/A to $206/A</td><td>Net Loss:
$2.1 million to $4.9 million</td></tr>
</table>

Scenario	Region	Grower Level Impact	Region Level Impact	National Level Impact
3 REIs: AZM: >14 days (AZM not used) Phosmet: >3 days (Phos not used)	East	**Net Loss:** $166/A to $333/A	**Net Loss:** $27.3 million to $54.4 million	**Net Loss:** $70.7 million to $157.2 million
	West	**Net Loss:** $257/A to $613/A	**Net Loss:** $43.2 million to $102.8 million	
4 REIs: AZM: =/<14 days, 1 app. Phosmet: =/<3 days	East	**Net Loss:** $51/A	**Net Loss:** $8.4 million	**Net Loss:** $15.1 million to $25.1 million
	West	**Net Loss:** $40/A to $100/A	**Net Loss:** $6.7 million to $16.7 million	

In addition to the impacts presented above associated with the hypothetical scenarios, there are unquantifiable impacts that should be considered. These impacts are no less important and could increase the estimated dollar impacts significantly. Apple production is a complex, multi-faceted business requiring a staggering amount of information in order to make the best possible decision for each input parameter to the production of that crop. Never mind the parameters that are outside of a grower's control, such as weather, market prices, availability of labor, regulatory actions, etc. All these elements, and many more, play a crucial role in a grower's ability to post a positive return on their investment. However, there are several factors that could affect growers' net returns as a result of modifications to AZM and phosmet's current use patterns, including the disruption of existing IPM programs developed over many years and built around the use of AZM and phosmet. There is a research and management cost associated with a disruption such as this that may impact growers in unforseen ways for years to come. Examples of other qualitative elements that could severely impact growers include outbreaks of secondary pests, development of pest resistance to alternative pest control methods, availability of hand labor to complete critical cultural practices in shortened periods of time, damaged reputations for producing and potentially shipping insect-contaminated fruit in domestic and export markets, and anticipated losses because of rejected loads at the pack-house and processor for insect-contaminated fruit.

This assessment utilizes information and data available to BEAD as of August 1, 2001. Any information received after this date will be considered and possibly incorporated, as appropriate, in subsequent iterations of this analysis.

Outline of Assessment

The structure of the biologic and economic assessment of the use of azinphos-methyl and phosmet on apples will follow the outline provided below. The main elements of the assessment will be split into a biological assessment of the use of AZM and phosmet on apples grown throughout the United States and an economic assessment of the impacts on net revenues caused by various modifications on existing use patterns. By region, the assessment will describe the production and cultural practices of growing apples; the use of AZM and phosmet including the percent of crop treated, average application rates, the number of applications, target pests, and the timing of applications; potential pest control alternatives; and the quantitative and qualitative impact on growers of the hypothetical risk reduction scenarios. For information on risk reduction achieved bye the extensions of the REIs please refer to the occupational and residential human health risk assessment on the Agency's website (http://www.epa.gov/pesticides/op) for information concerning the worker risks associated with the restricted entry intervals for azinphos-methyl and phosmet.

Scope and Limitations of Assessment

The scope of this analysis will attempt to identify potential grower-level, regional-level and national impacts on growers associated with various regulatory constraints placed on the use of AZM and phosmet in apples. The restrictions that serve as the basis for our impact estimates in this report reflect mitigating post application risks to workers entering treated areas identified by the Health Effects Division of the Office of Pesticide Programs. This analysis does not attempt to address impacts associated with mitigation efforts targeted at workers engaged in mixing, loading, or applying AZM or phosmet to apples or potential mitigation for various environmental risks (i.e., risk mitigation for risks to terrestrial plants and organisms or water contamination).

There are limitations to our assessment. In the summer of 1999, the Agency instituted changes to the registration of AZM and cancelled the use methyl parathion on apples. In 2000, post-bloom use of chlorpyrifos was cancelled. These relatively recent changes to the registration status of these insecticides, which are (or were) all used on a large percent of the US apple acreage, have yet to fully impact growers. This analysis does not estimate impacts for the many different varieties that are commercially grown. The impacts estimated by this analysis only represent potential short-term--1 to 2 years--impacts that may occur on the apple production system. Assumptions about yield and quality losses associated with the various scenarios are based on the best professional judgement of BEAD analysts because estimates were not available from other sources. The basis for these assumptions is based on information in available USDA crop profiles, information and data from the US Apple Association, state crop production guides, discussions with university extension and research entomologists knowledgeable in apple production, and the many other sources listed.

Based on available information, BEAD has attempted to quantify impacts to growers associated with extending post-application reentry intervals for AZM and phosmet on apples. To complete this task, we developed four (4) hypothetical mitigation scenarios with the aim at assessing the individual benefits of the use of AZM and phosmet:

- Scenario 1 - Azinphos-methyl REI >14 days, and phosmet REI less than or equal to 3 days. Azinphos-methyl would no longer be used by growers.
- Scenario 2 - Azinphos-methyl REI equal to 14 days, and phosmet REI >3 days. Phosmet would no longer be used by growers.
- Scenario 3 - Azinphos-methyl REI >14 days, and phosmet REI >3 days. Both azinphos-methyl and phosmet would no longer be used by growers.
- Scenario 4 - One application of azinphos-methyl at an REI equal to 14 days, and phosmet REI less than or equal to 3 days.

Geographically, BEAD has traditionally assessed US apple production in five regions: Pacific Northwest (WA, OR, ID), Pacific Southwest (CA, AZ), North Central (MI, OH), New England (CT, ME, MA, NH, NJ, NY, RI, VT), and Appalachian/Southern (DE, GA, MD, NC, PA, SC, TN, VA, WV). States were grouped regionally in this way based on similarities in climatic conditions, production practices, and pests. However, for the purpose of this analysis, BEAD has aggregated the five distinct regions into two, the West (Pacific Northwest and Pacific Southwest) and East (North Central, New England and Appalachian/Southern). This was done in part to simplify the assessment, but more because BEAD found that when evaluating the potential impacts associated with each scenario there were distinct similarities between the three regions grouped in the East and the two regions grouped in the West. Similarities in use patterns for AZM and phosmet, target pests, climatic conditions, cultural practices, market destinations (fresh v. processed) and predicted modifications in use patterns and use of alternatives led to the five regions being aggregated to two. Therefore, grower-level impacts on net revenues are presented for only two regions, the aggregated East and West. For region-level net revenue impacts, we calculate impacts at the aggregated region-level (East or West) and then dis-aggregate the impacts to the sub-region level. For example, regional-level net revenue impacts are presented for the East region and then dis-aggregated to show the contribution to the regional-level impacts from each sub-region, the North Central, New England and Appalachian/Southern. The same is done for the West region. Net revenue impacts are also aggregated across regions for a national-level impact estimate for each scenario.

Apple production is a very complex system that can be impacted by any number of things. BEAD's ability to quantitatively capture the wide array of events that could unfold given each hypothetical scenario listed above is very limited. Those elements that we have been unable to quantify will be discussed in a qualitative fashion in an attempt to inform risk managers that additional--but not less important--unquantifiable events could occur if additional regulatory restrictions are placed on AZM or phosmet. The contribution of these unquantifiable impacts to the overall impact of any modifications to existing use patterns of AZM or phosmet could be significant.

The impacts associated with these unquantified elements could conceivably increase the estimated impacts by several-fold.

Background of US Apple Production

The apple (*Malus domestica* Borkh.) has existed for the length of recorded history and is believed to have originated in the Caucasus. European settlers of the Americas brought seeds and cuttings from England because they found the native crabapple to be relatively inedible. Other Europeans brought apple stock to Virginia and the Southwest, and a Massachusetts man, John Chapman, became famous for planting trees throughout Ohio, Indiana, and Illinois (his name became "Johnny Appleseed") in the late 1700's and early 1800's.

There are approximately 2,500 known varieties of apples grown in the United States and more than 7,500 varieties grown worldwide. Of the 2,500 varieties grown in the US, approximately 100 are grown commercially with 15 popular varieties accounting for over 90 percent of production. Apples are grown in every state in the continental US and grown commercially in 36 states. Top-producing states include Washington, New York, Michigan, California, Pennsylvania, and Virginia. In 2000, there were approximately 464,600 acres of bearing apple trees grown in the US producing 10.6 million pounds of fruit with a value of over $1.4 billion. According to statistics published by the US Apple Association, in 1999, 56 percent of the apple crop was eaten as fresh fruit, 42 percent was processed into apple products, and 2 percent was not marketed. More than 11% of the fresh was exported in 1999, and of the 42 percent of 1999 US apple production that was processed: 23 percent were processed for juice and cider, 3 percent were dried, 2 percent were frozen, and 13 percent were canned. Other uses for processed apples included baby food, apple butter or jelly, and vinegar.

Since 1995, the apple industry has been facing a great deal of uncertainty. An increase in domestic production during the 1990's, together with increased competition in domestic and export markets from countries such as China, Chile, and Italy, has resulted in lower prices received in 1999 for fresh (down 12% from 1995 prices) and processed (down 20% from 1996 prices) market apples. In response to the depressed market, the U.S. government has made available $138 million in market loss and disaster assistance for apple growers, $99 million in low interest loans, and USDA has purchased $81 million worth of apples the last two crop years for their school lunch program. Prices rebounded slightly in 1999 (processed market prices increased 28% from 1998 prices, and fresh market prices increased 22% from 1998 prices), but continued high production and competition, domestically and abroad, could keep apple prices depressed, which could threaten the viability of the apple grower.

East Region

Apple Production and Cultural Practices in the East

The East Region is comprised of the apple producing states of the North Central, New England, and Appalachian/Southern regions. Approximately 44 percent of the bearing acres in the US are located in this region and they account for 34 percent of the US apple production with a value over $420 million. Table 4 lists apple production in the US and the East Region.

Table 4. Apple Production and the Value of Production in the US and the East Region [1]

US/Region	Bearing Acreage (acres)	Production (million pounds)	Percent of US Production	Percent of Region Production	Value of Production ($1,000)
US	464,500	10,605	–	–	$1,434,394
East Region	203,900	3,611	34%	--	$423,524
North Central States [2]	61,100	1,153	11%	32%	$110,962
New England States [3]	77,700	1,338	13%	37%	$177,306

US/Region	Bearing Acreage (acres)	Production (million pounds)	Percent of US Production	Percent of Region Production	Value of Production ($1,000)
Appalachian/ Southern States [4]	65,100	1,120	11%	31%	$135,256

1. Source: USDA/NASS Noncitrus Fruits and Nuts 2000 Preliminary Summary.
2. North Central States include MI and OH.
3. New England States include CT, ME, MA, NH, NJ, NY, RI, and VT.
4. Appalachian/Southern States include DE, GA, MD, NC, PA, SC, TN, VA, and WV.

Table 5 lists apple production and the value of production by end use market for the US and East Region. As is evident from the information listed in the table, 60 percent of the production in the East Region is destined for the processed market. The region also accounts for nearly 50 percent of the total US production that is processed while only 23 percent of US fresh production. There is a significant difference in price paid for apples destined for the fresh market when compared to the price received for processed apples. The value of production in the East Region is approximately $0.19 per pound for fresh production and $0.07 per pound for processed apples.

Table 5. Apple Production and the Value of Production in the US and the East Region by End Use Market [1]

US/Region	Production (million pounds)			Value of Production ($1000)		
	Total	Fresh	Processed	Total	Fresh	Processed
US	10,605	6,204	4,401	$1,434,394	$1,194,278	$390,116
East Region	3,611	1,434	2,157	$423,524	$270,840	$148,364
North Central States [2]	1,153	408	746	$110,962	$65,662	$45,300
New England States [3]	1,338	660	675	$177,306	$129,031	$47,402
Appalachian/ Southern States [4]	1,120	366	736	$135,256	$76,147	$55,662

1. Source: USDA/NASS Noncitrus Fruits and Nuts 2000 Preliminary Summary.
2. North Central States include MI and OH.
3. New England States include CT, ME, MA, NH, NJ, NY, RI, and VT.
4. Appalachian/Southern States include DE, GA, MD, NC, PA, SC, TN, VA, and WV.

This region spans a wide geographic area from both East to West and North to South. With such a wide geographic area covered in this region, there are slight differences in cultural practices and when during the year the tree, fruit, and pests develop. In the more southern zone of this region (e.g., VA, Carolinas, TN), the trees and fruit develop earlier in the season because temperatures are warmer than in the northern reaches of the region (e.g., MI, NY, MA). Pests also develop earlier in the southern part of this region as well. Considering this, however, there is little difference amongst growers in this region and the various cultural practices they use to manage their orchards.

In general, petal fall, a critical timing when either AZM or phosmet are almost always used, occurs from late April to mid-May within this region. Approximately 7-14 days following the petal fall application, growers begin cover sprays every 10-21 days until late summer or early fall depending on pest pressure. Harvest activities generally begin in August with the earliest maturing varieties and reach a peak in mid-September through October for the East region.

There are a number of activities that would require workers to enter an orchard during the growing season other than to make pesticide applications. Some are general maintenance activities that result in little to no foliage and fruit contact, such as mowing between tree rows, while others are high contact activities like hand thinning. In the East Region the primary high contact foliage and fruit contact activities include hand thinning, summer pruning, hand harvesting, tree training, and placement of pheromones for mating disruption.

As is the case with all apple acreage in the US, 100 percent of the acreage in the East Region is hand harvested. Hand thinning of fruit is the next most common activity that would require workers to reenter fields following pesticide applications. Approximately 20 to 40 percent of the apple acreage in the East is hand thinned and occurs from early June through mid-August in the East Region. Hand thinning is an important activity that is used as a supplement to chemical thinning. Fruit thinning is an important cultural activity for a variety of reasons. First and foremost, fruit thinning is used to reduce the crop load on a tree. Trees regularly over-produce the number of blossoms necessary to produce a healthy crop. Only about five (5) percent of the blossoms on a full bloom tree are necessary for a full crop. By thinning a tree, either blossom thinned and/or fruit thinned, growers are promoting return bloom in subsequent years and annual production, eliminating small fruitlets, improving fruit size and coloring, and reducing pest problems. Thinning is a particularly important activity for apples destined for fresh markets because of the affect proper thinning can have on fruit sizes. Work crews spend about 25 to 40 hours of labor per acre hand thinning at the rate of approximately $7.50 to $8.00 per hour.

The next most common cultural activity in the East Region that results in a generally high amount of foliage contact is summer pruning which occurs on an estimated 10 to 40 percent of the acreage. The practice of summer pruning is best used in combination with the more common practice of dormant pruning which occurs during the winter months. Summer pruning helps improve fruit color, alter fruit quality, train trees, and allow better distribution of the labor force. Summer pruning generally occurs from mid- to late-June through the end of August and coincides with the same time that hand thinning would occur.

The last two cultural activities that could result in post-application exposure to workers are tree training and placement of pheromone mating disruption ties, which occur with limited regularity in the East Region. Tree training and pheromone mating disruption occur on an estimated 3 to 15 percent and 0 to 5 percent of the acreage, respectively, in the East. The amount of tree training that occurs depends on the rootstock used and the orchard layout and design. Orchards grown on trellis systems generally require a much higher degree of tree training and labor input than orchards not on these systems. Training of the branches is required to insure proper growth habits and sufficient support in later years for the apple load they will carry, and for the promotion of good growth characteristics that will allow for sun penetration and early fruit production. Workers conducting tree training activities could be in the orchard any time from mid-May through mid-July in the East Region.

Pheromone mating disruption for codling moth is a widely accepted practice in the West Region, but in the East it has met with limited success and, therefore, adoption rates are low. It is estimated that less than 5 percent of the acreage in the East practices pheromone mating disruption. The majority, if not nearly all, of this acreage is located in MI, where it is estimated that 10 percent of the acreage is currently treated with pheromone mating disruption. Workers who apply the pheromone emitting twist ties to trees can be in the orchard at various times from mid-April to mid-May.

Azinphos-methyl and Phosmet Usage and Target Pests in the East Region

AZM and phosmet are both used in the East Region. There may be as many as six applications of azinphos-methyl and phosmet throughout the season, but on average there are 3 phosmet and 3 azinphos-methyl applications. Average rates per application for phosmet range from 1.0 to 1.3 pounds active ingredient per acre, and for azinphos-methyl from 0.5 to 0.7 pounds active ingredient per acre. Table 6 list the usage of azinphos-methyl and phosmet on apples in the US and the East Region. On average, more than 75% of the US and the East apple bearing acreage is treated with azinphos methyl per year. Nearly 25% of the US apple bearing acreage and more than 40% of the East apple bearing acreage is treated with phosmet per year.

Table 6. Usage of Azinphos-methyl and Phosmet on Apples in the US and the East Region [1]

US/Region	Percent of Crop Treated	Base Acres Treated (1000 acres) [2]	Rates (lbs. ai/Acre)	Average # of Applications/Yr.	Total Pounds Applied (1000 lbs)
Azinphos-methyl Usage					
US	78%	362	0.7	3	636
East Region	80%	162	0.5 - 0.7	3	236
North Central[3]	87%	53	0.7	3	110
New England[4]	75%	58	0.6	3	86
Appalachian/ Southern[5]	78%	51	0.5	3	40
Phosmet Usage					
US	24%	112	1.4	2	267
East Region	41%	84	1.0 - 1.3	2	188
North Central[3]	60%	37	1.3	2	107
New England[4]	33%	26	1.2	2	48
Appalachian/ Southern[5]	32%	21	1.0	2	33

1. Source: USDA/NASS Fruit and Nut Chemical Use, 1997 and 1999.
2. Base acres treated calculated using percent of crop treated estimates and bearing acreage from Table 1.
3. North Central States include MI and OH.
4. New England States include CT, ME, MA, NH, NJ, NY, RI, and VT.
5. Appalachian/Southern States include DE, GA, MD, NC, PA, SC, TN, VA, and WV.

Target Pests in the East Region -

The primary target pests for AZM and phosmet applications in the East Region are codling moth, plum curculio, apple maggot, oriental fruit moth, leafroller species, tarnished plant bug, European apple sawfly, and San Jose scale. These pests are all direct apple pests, which are pests that directly attack the fruit causing yield and quality losses. There are several other pests that applications of AZM and phosmet control when they are used to target this group of pests. Often the grower is not even aware that other pests are being controlled.

Codling moth (*Cydia pomonella*) is the most important pest of apples in the US and is a primary target for AZM and phosmet applications in the East. This is a primary feeder within apples that makes the fruit unmarketable. Without effective control, losses can range from 50 to 90% of the crop. There are two to three generations in the East Region. The insect overwinters as a mature larvae with the adult emerging around full bloom. The adult lays eggs on the fruit and when the egg hatches the larva burrows into the apple creating large tunnels and making the fruit unmarketable. After feeding within the apple for approximately three weeks, the larva emerges and seeks a pupation site. After two to three weeks in the pupal stage, the adult emerges for a second generation usually beginning in the month of July and continuing to mid-August. A third-generation can occur in the southern zone of the East Region on a regular basis, whereas in the northern zone of the Region a third-generation generally occurs only in exceedingly warm years. There is a potential for five or more azinphos-methyl and phosmet applications during activity - two with first generation, and three or more with second and third generation. Control of codling moth is often achieved with applications of AZM or phosmet targeted at plum curculio and apple maggot. The pest is present during the time period that hand thinning, tree training, and summer pruning activities occur in June, July, and August.

Plum curculio (*Conotrachelus nenuphar* Herbst) is also one of the most important insects attacking apples in the East. Adults typically migrate into orchards from adjacent woodlots in the spring around bloom time (mid-April to early May). Curculio dispersal from overwintering sites to orchards is most reliably linked with either a maximum daily temperature of 75 /F for two to three days, or a mean daily temperature of 55-60 /F for three to six days. Spring migration lasts about six weeks. Peak activity and the critical time for control of plum curculio is during a two to three week period beginning at petal-fall. In the southern reaches of the Region plum curculio can have two to three generations per year resulting in later season applications (ca. July). The adult lays an egg under the skin of the fruit leaving a crescent-shaped scar on the surface of the apple. In apple most eggs do not hatch, so the damage is cosmetic to the fruit surface which can cause fruit to be diverted to the process market rather than fresh. When the larvae do hatch, they burrow throughout the apple creating brown trails. After several weeks the larva emerges from the apple and falls to the ground where it pupates until fall. On occasion there is fruit surface feeding in the fall. The resulting damage from either the internal feeding, egg laying and fall adult feeding make the fruit unmarketable. Damage from this pest can range from 50-90% without control and they commonly infest 100% of backyard fruit trees and abandoned orchards. There is potential for two to three azinphos-methyl or phosmet applications during peak plum curculio activity. These applications can coincide with hand thinning, tree training, summer pruning, and pheromone mating disruption placement in mid-to-late June through July.

Apple maggot (*Rhagoletis pomonella* Walsh) is a native pest that feeds on a variety of fruit, has essentially no natural enemies, and will thrive in an abandoned orchard setting. Processors and fresh shippers have zero tolerance for apple maggot infested fruit, because of the distasteful flavor and odor left in the apple after feeding by the apple maggot larvae. The adult fly emerges in mid-June to early July and lays eggs within the apple. The apple maggot causes two forms of injury. The flesh surrounding a puncture where eggs are deposited in immature fruit often fails to grow with the rest of the apple and becomes a sunken, dimple-like spot in the surface. When the larvae feed and move through the fruit, they leave a characteristic brown trail through the flesh of the apple that can readily be seen when the fruit is cut open. Apples injured early in the season usually drop prematurely. Infested fruit are unmarketable and a zero tolerance for damage exists for export purposes. Controls for apple maggot have traditionally been spray applications on 8-10 day intervals to kill adults before they oviposit in the apple. Damage from the apple maggot can reach 50-100% if left uncontrolled. Due to the zero tolerance, effective controls are essential. There is a potential for three or more azinphos-methyl or phosmet applications during peak apple maggot activity. Activity coincides with hand thinning, summer pruning, and hand harvesting in July and August.

Oriental fruit moth (*Grapholita molesta* Busck) has become a major pest in recent years that AZM and phosmet applications are targeted for in the East. Oriental fruit moth historically has been considered a more serious problem in peach than in apple. In recent years, however, it has become a major pest of apples in the eastern US. Peach orchards in the vicinity will increase the chance of infestation but oriental fruit moth can be a serious problem in apple orchards when there are no nearby stone fruit orchards. There are three to four full generations in the East depending on your locale within the region and weather conditions. The first generation larvae bore into apple shoots. Subsequent generations feed within the apple and make the fruit unmarketable. The last generation is especially problematic as larvae hatch from mid-August to mid-September near or during harvest and can be a major cause of wormy fruit, often with little or no sign of injury. There is a potential for two to six azinphos-methyl or phosmet applications during oriental fruit moth activity. Activity coincides with pheromone mating disruption placement, hand thinning, tree training, summer pruning, and hand harvest worker activities throughout the season.

Various leafroller species, primarily red-banded leafroller (*Argyrotaenia velutinana* Walker) and oblique-banded leafroller (*Choristoneura rosaceana* Harris), are problems throughout the East Region, but some areas are more prone to damaging infestations from one more than the other. Oblique-banded leafroller infests apple, pear, cherry, plum, peach, rose, raspberry, gooseberry, currant, strawberry, and many weeds. Damage from overwintering larvae occurs primarily during the pre-bloom to bloom period. This first group of larvae feed on floral parts destroying the fruit buds. Most fruit damaged at this time drop from the tree before harvest. In late July the larva of the summer generation can be found feeding actively on growing terminals and on fruit where they feed underneath a protective covering of leaves. Summer feeding injury leaves the fruit unmarketable and can result in over 50% crop loss. The red-banded leafroller injures both foliage and fruit. The injury to the foliage is of little significance except when infestations are extremely high. Injury to fruit is the main concern to the grower. First generation larvae feed on apples in June and early July when the fruits are small, making irregular, shallow cavities in the fruit. Some of these young fruits may be so severely damaged that they do not survive. The injured areas gradually cork over, and the apples usually develop into deformed or misshapen culls. Injury by second- and third-brood red-banded leafroller larvae occurs where a leaf is webbed to an apple or where apples are present in a cluster. The larvae eat the skin and the flesh immediately beneath. Feeding areas are shallow and irregular and may be of considerable size, particularly when several larvae feed on one fruit. Second- and third-brood injury occurs so late in the season that the fruits--except possible hard winter varieties--are incapable of corking over the wounded tissue. Usually, however, second- and third-brood feeding areas are sources of infection for various rots and allow rapid moisture losses. Injured apples do not store well. When a high percentage of crop is affected, it has been found impractical to sort out the uninjured apples. Consequently, whole crops have been abandoned. There is a potential for two to five azinphos-methyl or phosmet applications during leafroller activity. Applications coincide with workers conducting pheromone mating disruption placement, hand thinning, summer pruning, tree training, and hand harvesting.

The tarnished plant bug (*Lygus lineolaris* Palisot de Beauvois) is a true bug with piercing, sucking mouthparts that causes injury to tree fruits when it feeds and lays eggs. Adult tarnished plant bugs feed on flower buds beginning in early April, doing most damage around bloom. Damaged buds exude a gummy liquid and shrivel up. Adults also oviposit into and feed on young fruit after bloom, resulting in pitted, deformed fruit. There is a potential for one azinphos-methyl or phosmet application, usually around the time of petal fall, during the time that tarnished plant bugs are present. Applications could coincide with worker activities for pheromone mating disruption placement.

European apple sawfly (*Hoplocampa testudinea* Klug) also attacks fruit just after bloom and can cause significant damage that often results in the fruit being aborted. Damage is often similar to that caused by the tarnished plant bug. There is a potential for one to two azinphos-methyl or phosmet applications during the time that European apple sawfly are present. These applications would likely occur around petal fall and could coincide with worker activities for pheromone mating disruption placement.

The last pest in the East that AZM and phosmet are primarily used to control is the San Jose scale (*Quadraspidiotus perniciosus* Comstock). Infested trees show a general decrease in tree vigor, growth, and productivity. Under heavy infestation, twigs are crusted over with the scale, and smaller twigs and some branches are killed. On the fruit, feeding is most abundant around the blossom and stem ends and often results in a gray patch around the calyx of apples. Infested fruit have a spotted or mottled appearance because of a small red inflamed area surrounding each scale. The scale overwinters on the tree in an immature stage, surviving in higher numbers after relatively mild winters. They complete their development in the early spring and are most vulnerable to control measures during this maturation period. Each female then produces several hundred live young (crawlers) over a six week period. These crawlers disperse onto the twigs and fruit during June and July. These settle, develop a waxy scale cover, and feed by sucking sap from the tree. The crawlers mature, and produce a second generation of crawlers, often in much higher numbers than the first generation, during August through October. These scale often move onto the fruit. One scale can cause a fruit to be discarded during the packing process, and presence of scale is often considered a quarantine violation in international trade. There is a potential for two to four azinphos-methyl or phosmet applications during activity. Applications could coincide with tree training, hand thinning, and summer pruning in June, July, and August.

Potential Pest Control Alternatives

For the key target pests, codling moth, plum curculio, apple maggot, and oriental fruit moth, there are limited non-OP alternatives to phosmet and azinphos-methyl. With the removal of methyl parathion from use on apples and the restriction placed on chlorpyrifos usage to applications only before bloom, OP alternatives are limited as well. Both of these compounds were effective alternatives to post-bloom uses of both AZM and phosmet when they were still available.

The primary reasons that the OP's are currently the pest control methods of choice for these critical pests are the demands for worm-free and blemish-free produce in the fresh market for which most US production is initially targeted and the negligible tolerance for infested fruit in the alternate processing market. The necessity for complete control of these pests is even greater when apples are produced for export markets which have a zero tolerance and, in some cases, quarantine provisions.

Pheromone mating disruption for codling moth can be used as an alternative control method. However, mating disruption in the East (primarily in MI which has the most experience attempting to utilize mating disruption) appears to be less efficacious than in the

Western US. There are two primary reasons that pheromone mating disruption does not seem to be as effective in the East when compared to the results found in the West: 1) orchard configuration, and 2) influx of high numbers of codling moth from adjacent habitats. Orchards in the East region tend to be much smaller in size and irregular in shape, which has a negative influence on the ability of the pheromones to reach an air saturation level to be effective. Perhaps the more limiting factor that does not allow mating disruption to achieve the success it has in the West is the much higher population levels of codling moth present in the East. There is a much higher percentage of unmanaged apple trees (abandoned orchards and backyard trees) in the East than the West, and this creates a reservoir of pests that can continuously migrate into managed orchards and create problems for growers. Mating disruption has been most successful in areas where the pest pressure is low to moderate. Even with moderate codling moth populations, mating disruption often needs to be supplemented with a chemical application–most often AZM or phosmet. Furthermore, the necessary use of AZM and phosmet to control plum curculio, oriental fruit moth, and apple maggot in the East will control codling moth populations whether mating disruption is practiced or not, so most growers choose to avoid the extra expense of initiating and maintaining a mating disruption program.

Synthetic pyrethroids (e.g., esfenvalerate and permethrin) are efficacious against these primary target pests. However, nearly all states currently do not recommend use of synthetic pyrethroids post bloom because they tend to cause outbreaks of mite populations which can be damaging to the apple trees. The synthetic pyrethroids are extremely damaging to natural mite predator populations which can often be quite effective at maintaining mite populations below damaging levels. Conventional wisdom is that the use of pyrethroids will result in mite outbreaks, which would lead to increased applications of very costly miticides.

Some of the other pest control alternatives to azinphos-methyl and phosmet include *Bt,* carbaryl, methomyl, indoxacarb, pyriproxyfen, thiamethoxam, spinosad, methoxyfenozide, tebufenozide, and kaolin clay. While all of these compounds can provide some level of control of one or more of the target pests, none of these alternatives control the broad spectrum of pests that azinphos-methyl and phosmet control. Some of these compounds can lead to secondary pest outbreaks as well. Below is a detailed summary of each potential pest control alternative to AZM and phosmet.

- *Bacillus thuringiensis* (*Bt*) (various products) - *Bt* can be used for control larval stages of various leafroller species, including red-banded and oblique-banded leafrollers. Must be ingested by the larvae for effective control so application timing is critical. Not generally effective against codling moth and oriental fruit moth larvae because these larvae feed internally and may not ingest enough toxin. Four (4) hour REI and a 0-day PHI.
- Carbaryl (Sevin) - A carbamate that is moderately effective for apple maggot and codling moth, but must use higher label rates to achieve residual control longer than seven (7) days. Because carbaryl has such a short residual window when it can control these target pests, it is rarely used by growers for insect control. Carbaryl is toxic to beneficial insects and mites and disruptive to established integrated pest management (IPM) systems; it is also highly toxic to bees. If late season infestations of apple maggot occur, carbaryl may be used because of its short PHI, but this is currently not a common practice. Carbaryl is primarily used as a fruit thinning agent at reduced rates before 30 days after petal fall. Twelve (12) hour REI and a 1- to 3-day PHI.
- Methomyl (Lannate) - A carbamate insecticide that is moderately effective against apple maggot, codling moth, and leafrollers. Methomyl has a relatively short residual activity (5-7 days) which means it must be reapplied much more frequently than AZM and it would be cost prohibitive. Like carbaryl, methomyl is highly toxic to mite predators and an important aphid predator, possibly causing outbreaks of these pests. 48 hour REI and a 14-day PHI.
- Indoxacarb (Avaunt) - Registered in late 2000 so 2001 will be the first use season, not registered in CA. Indoxacarb is a member of the new oxadiazine class of insecticides that acts by inhibiting sodium ion entry into nerve cells, resulting in paralysis and death of the pest. Primary route of entry to the pest is by ingestion so thorough coverage of the crop is critical for good pest control. Target pests on label include codling moth, oriental fruit moth, red-banded leafroller, and plum curculio. Considered to be weaker than AZM and phosmet for codling moth and the other pests even when applied at more frequent intervals. More expensive than both AZM and phosmet. Label states for use West of the Rockies to use only against low to moderate infestations of codling moth in conjunction with alternate control measures, such as established mating disruption. 12 hour REI and 28-day PHI.
- Pyriproxyfen (Esteem) - Registered in 1999, pyriproxyfen is an insect growth regulator (IGR) that acts by suppressing embryo genesis within the insect egg and by inhibiting metamorphosis and adult emergence of target insects. Target pests on label include codling moth and San Jose scale. Considered to be weaker than AZM and phosmet for codling moth and the other pests even when applied at more frequent intervals. Because its activity is only on eggs, it must be present on foliage prior to

egg-laying. Will likely only be used on first brood codling moth because of its long PHI. Much more expensive than AZM and phosmet. There is concern about resistance developing to pyriproxyfen following repeated use. 12 hour REI and 45-day PHI.

- Thiamethoxam (Actara) - Registered early in 2001, this is the first use season for this neonicotinoid insecticide that will likely be used against plum curculio and European apple sawfly. Not considered to be as effective as AZM and phosmet, thiamethoxam is only recommended for a single application at petal fall and using different insecticides for later applications if necessary. More expensive than AZM and phosmet. Further testing and in-field use will better delineate the eventual use pattern recommended for thiamethoxam. 12 hour REI and 35 day PHI.
- Spinosad (Spintor) - Registered in 1998, spinosad belongs to a new Naturalyte class of insecticides and is a waste metabolite produced during the growth of a bacteria. It controls leafrollers, codling moth, and oriental fruit moth if pest pressures are low. Drawbacks to its use are its cost, estimated to be $33/acre per application, and the fact that it needs to be re-applied frequently at maximum rates to get acceptable control of these pests. 4 hour REI and 7 day PHI.
- Methoxyfenozide (Intrepid) - Registered in the summer of 2000 but has not received state registrations in NY and CA. Methoxyfenozide is an IGR in the diacylhydrazine class of insecticides that controls leafrollers, codling moth, and oriental fruit moth. Effective if pest populations are low to moderate and often recommended for use in combination with pheromone mating disruption. More expensive than AZM and phosmet. May be one of the primary alternatives to AZM and phosmet for codling moth and oriental fruit moth. There is concern about pests developing resistance to this class of IGRs; pest resistance to methoxyfenozide and cross resistance to the pyrethroids have already been reported in Europe. 4-day REI and 14-day PHI.
- Tebufenozide (Confirm) - Registered in 1995 and in the same class of chemistry as methoxyfenozide. Similar pest spectrum as methoxyfenozide, but considered to be less efficacious. Same concerns about resistance. More expensive than AZM and phosmet. 4 hour REI and 14-day PHI.
- Esfenvalerate (Asana) - Synthetic pyrethroid that has good to excellent efficacy against codling moth, oriental fruit moth, plum curculio, and tarnished plant bug; moderately effective on leafrollers and apple maggot. Although registered for use after petal fall, nearly all states recommend *against* using esfenvalerate after petal fall because of its toxicity to mite predators. Use of this material will most certainly cause mite populations to explode and require multiple acaracide treatments. Cheaper than AZM and phosmet. Historically, repeated use of synthetic pyrethroids has led to pests developing resistance to them. Effectiveness of synthetic pyrethroids can be decreased when temperatures are above 80° F. Long PHI may limit its use for late season pests. 12 hour REI and 21-day PHI.
- Permethrin (Ambush) - Synthetic pyrethroid that is effective primarily for tarnished plant bug, leafrollers, and plum curculio. Not labeled for control of codling moth or oriental fruit moth and use after petal fall. 24 hour REI and 14 day PHI.
- Pheromone Mating Disruption (various trade names) - Pheromone mating disruption (or confusion) has increased substantially since it first became available in 1991 with the first product aimed at the codling moth. Growers apply 160 to 400 pheromone-releasing devices per acre each season just prior to the flight of the first males. By releasing such high concentrations of pheromones in the orchard air, it very difficult for males to find and mate with females. Mating disruption pheromone products are now available for several pests, including codling moth, oriental fruit moth, various leafrollers and others. The greatest success to date has been with the codling moth. Approximately 50% of the acreage in the Pacific Northwest (90,000 acres) used codling moth mating disruption in 2000. Mating disruption is not generally considered a stand alone treatment in orchards with a history of moderate to high populations of the target pest, and growers must be selective in which orchard block they adopt this practice. Experience has shown that mating disruption should not be used under certain conditions - steep orchard slope, exposed windy site, uneven orchard canopy, or close proximity to unmanaged population. Use of mating disruption is very costly and not without risk. 0 day REI and 0 day PHI.
- Kaolin Clay (Surround) - The use of kaolin for fruit insect pest management is based on a new concept called Particle Film Technology. The objective of Particle Film Technology is to create a protective barrier between the plant (fruit or foliage) and the pest that 1) reduces host recognition of the pest, and 2) prevents normal movement and damaging activity of the pest. It can be applied through conventional orchard spray equipment. Complete coverage of the plant is critical for kaolin to be effective. Label claims control of oblique-banded leafroller and suppression of codling moth, plum curculio, and apple maggot. Multiple applications are necessary to attain sufficient coverage as well as to compensate for wash-off from rain, irrigation, or wind. There are some concerns that kaolin will disrupt integrated mite management and biological control of leafminer. Approved for use in organic production. Four (4) hour REI and 0-day PHI.

Restricted Entry and Pre-Harvest Intervals

The current label REI for azinphos-methyl is 14 days for hand harvest and hand thinning, and 48 hours for other activities except in areas where average rainfall is less than 25 inches a year then the REI is increased to 72 hours. The PHI is 14-days, or 21-days if the application is more than 1 pound ai per acre.

For phosmet, the current label REI is 1 day and the PHI is 7 days (in Eastern apples, 8 days, if mixed with methomyl). Please refer to the occupational and residential human health risk assessment on the Agency's website (http://www.epa.gov/pesticides/op) for information concerning the worker risks associated with the restricted entry intervals for both azinphos-methyl and phosmet.

Impact of Potential REI Extensions for AZM and Phosmet on Apple Production in the East Region

In general, the estimate of impacts in this analysis will be based on four hypothetical occupational risk mitigation scenarios focusing on changing the existing (REIs) for post-application worker (re-entry) activities. This analysis focuses on the potential impacts of these hypothetical use scenarios for AZM and phosmet on the agricultural community. More specifically, the analysis focuses on the impacts to crop producers from changes in pest control options and the concomitant changes in producer costs, crop yield, and quality. Cost increases may arise from using alternatives to AZM and phosmet to control certain pests, while yield and quality changes occur when these alternatives are not as effective (or even available) to control pests. While cost increases or yield and quality changes may result in increasing commodity prices, a detailed supply and demand price assessment for intermediate and final consumers of these crops is beyond the scope of this analysis. The impacts are presented in terms of changes in grower net revenue, where net revenues are equal to the revenues received by growers (price times quantity sold) minus the costs of production. The hypothetical scenarios that BEAD used to assess the potential impacts are listed below.

- Scenario 1 - Azinphos-methyl REI >14 days, and phosmet REI less than or equal to 3 days. Azinphos-methyl would no longer be used by growers.
- Scenario 2 - Azinphos-methyl REI equal to 14 days, and phosmet REI >3 days. Phosmet would no longer be used by growers.
- Scenario 3 - Azinphos-methyl REI >14 days, and phosmet REI >3 days. Both azinphos-methyl and phosmet would no longer be used by growers.
- Scenario 4 - One application of azinphos-methyl at an REI equal to 14 days, and phosmet REI less than or equal to 3 days.

Studies that have assessed grower- and regional-level impacts based on modifying a registered pesticide's use pattern, in this case by extending post-application REIs, were not available for our use. Therefore, for each scenario BEAD has made various assumptions and predictions on grower choices of alternate pest control methods if necessary. Based on available information, BEAD has also estimated changes in fruit yield and/or quality based on the changes in the pest control programs. The basis for our assumptions and predictions are based in large part on discussions and information collected from knowledgeable experts who work in apple pest management, publically available information, and our best professional judgement. We have attempted to quantify as much of the impacts as possible; however, there are certain components that can only be discussed qualitatively. For that reason, the impacts associated with each region and the four scenarios will be presented in two sections, Quantitative Impacts and Qualitative Impacts. The quantitative impacts section will contain estimates of use pattern changes for AZM and phosmet based on changes in REIs, yield loss estimates, quality loss estimates, and use of alternative pest control methods if necessary.

Quantitative Impacts -

Currently in the East Region, on average, AZM is applied three times per season and phosmet is applied three times per season.

- Scenario 1 - Azinphos-methyl REI >14 days, and phosmet REI less than or equal to 3 days. Azinphos-methyl would no longer be used by growers.

  Assumptions -

  1. Alternative Pest Control Program -

    a. 4 additional applications of phosmet (7 apps. total of phosmet on avg./yr) to achieve similar control as the 3 AZM applications.
    b. 1 application of spinosad for supplemental leafroller control.
2. No yield loss -
    a. Rationale - Assumed alternative pest controls would not reduce yields.
3. Potential quality loss of up to 3% (up to 3% of production will shift from sale on fresh market to process market; up to 3% of production will shift from sale on process market to no sale) -
    a. Rationale - Because alternative pest controls would need to be applied more frequently and critical pest control windows may be missed resulting in damaged fruit and/or insect contamination in harvested fruit.

- Scenario 2 - Azinphos-methyl REI equal to 14 days, and phosmet REI >3 days. Phosmet would no longer be used by growers.

    Assumptions -
    1. Alternative Pest Control Program -
        a. 2 additional applications of AZM (5 apps. total of AZM on avg./yr).
        b. 1 application for methoxyfenozide because of its shorter REI (4 hours) to not interrupt hand thinning activities.
        c. 1 application of esfenvalerate for late season pest control.
    2. No yield loss -
        a. Rationale - Assumed alternative pest controls would not reduce yields.
    3. 0-3% Quality loss (up to 3% of production will shift from sale on fresh market to process market; up to 3% of production will shift from sale on process market to no sale) -
        a. Rationale - Because alternative pest controls would need to be applied more frequently and critical pest control windows may be missed resulting in damaged fruit and/or insect contamination in harvested fruit.

- Scenario 3 - Azinphos-methyl REI >14 days, and phosmet REI >3 days. Both azinphos-methyl and phosmet would no longer be used by growers.

    Assumptions - There is a potential for two different spray programs (at least) to be adopted, depending on the availability of compounds in a particular state or region. For example, methoxyfenozide is not registered in New York, so they would not likely choose spray program 1.
    1. Alternative Pest Control Program 1 (SP1) -
        a. 3 applications of methoxyfenozide (not registered in NY) for codling moth, oriental fruit moth, and leafrollers.
        b. 1 application of tebufenozide because it has a short REI (4 hrs) and for control of codling moth, oriental fruit moth, and leafrollers.
        c. 2 applications of thiamethoxam for plum curculio and European apple sawfly.
        d. 1 application of spinosad for late season oriental fruit moth because of its short PHI.
        e. 2 applications of indoxacarb for apple maggot control
    2. Alternative Pest Control Program 2 (SP2) -
        a. 4 to 6 applications of synthetic pyrethroids (4-5 of esfenvalerate, 1-2 of permethrin) for codling moth, oriental fruit moth, plum curculio, and apple maggot.
        b. 2 applications of indoxacarb for supplemental control of apple maggot.
        c. 1 to 3 additional miticide (abamectin or pyridaben) applications because use of pyrethroids will disrupt biological control.
        d. 1-2 applications of imidacloprid for aphids and leafminers because use of pyrethroids will disrupt biological control.
        e. 1 application of *Bt* for leafrollers.
        f. 1 application of spinosad for leafrollers.
    3. 1% Yield Loss regardless of spray program used -
        a. Rationale - alternative control programs would not provide equivalent efficacy and outbreaks of secondary pests could occur.
    4. 3 to 5% Quality loss - 3 to 5% of production will shift from sale on fresh market to process market; 3 to 5% of production will shift from sale on process market to no sale -

a. Rationale - alternative pest controls would need to be applied more frequently and critical pest control windows may be missed resulting in damaged fruit and/or insect contamination in harvested fruit.
b. Rationale - secondary pests could cause damage that reduced quality.

- Scenario 4 - One application of azinphos-methyl at an REI equal to 14 days, and phosmet REI less than or equal to 3 days.

Assumptions -

1. Alternative Pest Control Program -
   a. 2 additional applications of phosmet (5 total apps. of phosmet on avg./yr)
   b. 1 application of spinosad for leafrollers
2. No Yield Loss
3. 1% Quality Loss - 1% of production will shift from sale on fresh market to process market; 1% of production will shift from sale on process market to no sale -
   a. Rationale - alternative pest controls would need to be applied more frequently and critical pest control windows may be missed resulting in damaged fruit and/or insect contamination in harvested fruit.

Grower Level Impacts

Table 7 is a summary of the estimated impacts at the grower level for changing the REIs of azinphos-methyl and phosmet on apples in the East Region. The impacts of four potential scenarios are estimated. Each scenario represents a different set of REIs for azinphos-methyl and phosmet. Impacts are expected to be different depending on the scenario. The first row lists the current yield, prices, revenues, costs, and net revenues for apples in the East Region. The second through fifth rows list the estimate of impacts of changing the REIs of azinphos-methyl and phosmet as defined in each scenario. The net loss estimate (bolded) in the last column of each scenario is the difference between current net revenues (from row 1) and the estimated net revenues expected as a result of each scenario. (Please see General Assumptions section for a more complete discussion of the impacts.)

- The estimated impact of not having azinphos-methyl available for use on apples in the East Region (scenario 1) is a reduction in grower net revenues to -$1 per acre, which is a decline of more than 100% from current net revenues ($114 per acre).

- The estimated impact of not having phosmet available for use on apples in the East Region (scenario 2) is a reduction in grower net revenues to $62 per acre, which is a decline of nearly 50% from current net revenues ($114 per acre).

- The estimated impact of not having azinphos-methyl or phosmet available for use on apples in the East Region (scenario 3) is a reduction in grower net revenues to -$52 to -$219 per acre (depending on the spray program), which is a decline of 1½ to 3 times current net revenues ($114 per acre).

- The estimated impact of only having azinphos-methyl available for 1 application on apples (scenario 4) is a reduction in grower net revenues to $63 per acre, which is a decline of nearly 50% from current net revenues ($114 per acre).

Table 7. East Region Grower Level Impacts Summary

Scenario	Yield	Quality Impact (Price)	Revenues	Costs	Net Revenues
Current Situation	Current total: 17,720 lbs/A Fr: 7,090 lbs/A Proc: 10,630 lbs/A	Prices: Fr: $0.19/lb Proc: $0.07/lb	Current: $2,090/A	Current: $1,976/A	Current: $114/A
1 REIs: AZM : >14 days Phosmet: =/<3 days	Yield loss: None	Quality Change: 3% Total: 17,720 lbs/A Fr: 6,877 lbs/A Proc: 10,524 lbs/A No sale: 319 lbs/A	Change to: $2,044/A	Change to: $2,045/A	Change to: -$1/A **Net Loss:** $115/A
2 REIs: AZM : =/<14 days Phosmet: >3 days	Yield loss: None	Quality Change: 3% Total: 17,720 lbs/A Fr: 6,877 lbs/A Proc: 10,524 lbs/A No sale: 319 lbs/A	Change to: $2,044/A	Change to: $1,982/A	Change to: $62/A **Net Loss:** $52/A
3 REIs: AZM : >14 days Phosmet: >3 days	Yield loss: 1% Reduces Yield to: Total:17,543 lbs/A Fr: 7,017 lbs/A Proc: 10,526 lbs/A	Quality Change: 3-5% Fr: 6,666-6,807 lbs/A Proc: 10,000-10,210 lbs/A No Sale: 316-524 lbs/A	Change to: $1,991/A to $2,022/A	Change to: SP 1: $2,077/A SP 2: $2,074/A to $2,210/A	Change to: SP 1: -$55 to - $86/A SP 2: -$52 to - $219/A **Net Loss:** SP1: $169/A to $200/A SP2: $166/A to $333/A
4 REIs: AZM : =/<14 days, 1 app. Phosmet: =/<3 days	Yield loss: None	Quality Change: 1% Fr: 7,019 lbs/A Proc: 10,595 lbs/A No Sale: 106 lbs/A	Change to: $2,076/A	Change to: $2,013/A	Change to: $63/A **Net Loss:** $51/A

SP 1 refers to spray program 1, and SP 2 refers to spray program 2.
See General Assumptions section for a more complete discussion of the impacts.

Regional Level Impacts

Table 8 lists the impacts at the regional level of changing the REIs of azinphos-methyl and phosmet on apples in the East Region. The impacts of four potential scenarios are estimated. Each scenario represents a different set of REIs for azinphos-methyl and phosmet. Impacts are expected to be different depending on the scenario. Under each scenario, current and estimated net revenues are listed for the East Region and the three smaller regions (i.e., New England, Appalachian/Southern, and North Central Regions) comprising the East Region. (Please see General Assumptions section for a more complete discussion of the impacts.)

- The estimated impact of not having azinphos-methyl available for use on apples in the East Region (scenario 1) is a reduction in regional net revenues of as much as 88% from current net revenues in the East Region and the three regions comprising the East Region.

- The estimated impact of not having phosmet available for use on apples in the East Region (scenario 2) is a reduction in regional net revenues of as much as 27% from current net revenues in the East Region and the three regions comprising the East Region.

- The estimated impact of not having azinphos-methyl and phosmet available for use on apples in the East Region (scenario 3) is a reduction in regional net revenues of as much as 2 ½ times current net revenues in the East Region and the three regions comprising the East Region.

- The estimated impact of having azinphos-methyl available for only 1 application on apples in the East Region (scenario 4) is a reduction in regional net revenues of as much as 40% from current net revenues in the East Region and the three regions comprising the East Region.

Table 8. East Region Regional Level Impacts Summary

Scenario	Region	Net Revenues
1 REIs: AZM : >14 days Phosmet: =/<3 days	East	Current Total: $23.3 million New Total: $4.45 million Net Loss: $18.85 million
	New England	Current Total: $8.9 million New Total: $2.1 million Net Loss: $6.8 million
	Appalachian/Southern	Current Total: $7.4 million New Total: $1.5 million Net Loss: $5.9 million
	North Central	Current Total: $7 million New Total: $0.85 million Net Loss: $6.15 million
2 REIs: AZM : =/<14 days Phosmet: >3 days	East	Current Total: $23.3 million New Total: $18.7 million Net Loss: $4.6 million
	New England	Current Total: $8.9 million New Total: $7.3 million Net Loss: $1.6 million
	Appalachian/Southern	Current Total: $7.4 million New Total: $6.3 million Net Loss: $1.1 million
	North Central	Current Total: $7 million New Total: $5.1 million Net Loss: $1.9 million

Scenario	Region	Net Revenues
3 REIs: AZM: >14 days Phosmet: >3 days	East	Current Total: $23.3 million SP1: New Total: -$4.2 million to -$9.3 million Net Loss: $27.5 million to $32.6 million SP2: New Total: -$4 million to -$31.1 million Net Loss: $27.3 million to $54.4 million
	New England	Current Total: $8.9 million New Total: -$0.8 million to -$10.6 million Net Loss: $9.7 million to $19.5 million
	Appalachian/Southern	Current Total: $7.4 million New Total: -$1.2 million to -$2.8 million Net Loss: $8.6 million to $10.2 million
	North Central	Current Total: $7 million New Total: -$2 million to -$3.7 Net Loss: $9 million to $10.7 million
4 REIs: AZM : =/<14 days, 1 application Phosmet: =/<3 days	East	Current Total: $23.3 million New Total: $14.9 million Net Loss: $8.4 million
	New England	Current Total: $8.9 million New Total: $5.9 million Net Loss: $3 million
	Appalachian/Southern	Current Total: $7.4 million New Total: $4.8 million Net Loss: $2.6 million
	North Central	Current Total: $7 million New Total: $4.2 million Net Loss: $2.8 million

SP 1 refers to spray program 1 and SP 2 refers to spray program 2.
See General Assumptions section for a more complete discussion of the impacts.

Qualitative Impacts -

In addition to the impacts presented above associated with the hypothetical scenarios, there are unquantifiable impacts that should be considered. These impacts are no less important and could increase the estimated dollar impacts significantly. Apple production is a complex, multi-faceted business requiring a staggering amount of information in order to make the best possible decision for each input parameter to the production of that crop. Never mind the parameters that are outside of a grower's control, such as weather, market prices, availability of labor, regulatory actions, etc. All these elements, and many more, play a crucial role in a grower's ability to post a positive return on their investment. However, there are several factors that could affect growers' net returns as a result of modifications to AZM and phosmet's current use patterns.

Current fruit handling and marketing avenues (packers, processors, etc.) have a zero tolerance for apples infested with certain apple pests, namely the internal worms which would include codling moth, oriental fruit moth, and apple maggot, as well as others. Fruit packers and processors inspect every load delivered for various quality parameters that include visible insect damage. If any of these three pests are found, then the entire delivered load is rejected and the grower is left with the prospect of finding an alternative market or face a total loss. If the load being delivered was for fresh pack, then the grower may be able to divert it to the processing market to potentially salvage some of his costs. If the load was rejected at the processing plant (e.g., sauce, juice), then the grower essentially has no other market to divert to and takes a total loss on that product. While some of these losses were captured above, the concept with this scenario is that there is an upper threshold associated with crop damage or loss from a pest such as codling moth that, when exceeded, threatens the loss of the entire crop. That threshold has been estimated to be 2 to 3 percent of the fruit infested with pests like codling moth and oriental fruit moth. Because current fruit handling and packing systems are unable to sort volumes of fruit that exceed that threshold, packers will not accept fruit from a grower who they know have pest problems of that magnitude. Unless the grower was vertically integrated and could sort out the damaged fruit at considerable cost prior to packing, the crop could have no value or be valued only for juice at a greatly reduced price.

Another qualitative impact associated with the potential loss of either AZM or phosmet is the potential disruption of successful IPM programs that have been developed around applications of AZM and phosmet for critical pest control. Many years of research and in-field trial and error have gone into developing stable pest management programs that rely on the judicious use of AZM and phosmet in combination with crop protection tools. But this stability is fragile and changes in the pest management tools that growers currently use could jeopardize these IPM programs. Growers are currently adjusting their pest management programs to the loss of methyl parathion, the restriction on using chlorpyrifos post-bloom, and previous regulatory adjustments to AZM. Many of the newly registered alternatives (methoxyfenozide, thiamethoxam, pyriproxyfen, indoxacarb) have yet to be fully evaluated for their ability to fit into these programs or be used instead of existing control materials.

Many insects have traditionally been considered minor pests because broad-spectrum pesticides, which were applied to control a key pest species, effectively controlled them as well. If broad-spectrum pesticides are removed from the apple production system, many pests now considered minor will become more important and growers will need to find a way to control them. This represents a tremendous challenge since the pest complex that must be dealt with can be present in different growth stages ranging from eggs, larvae or worm, to adult flies and moths at the same time. Another facet of the same problem has been the trend towards registration of new pest control products that possess a narrow spectrum of activity, which controls only one specific pest or pest group. Growers are now experiencing great difficulty controlling the entire pest complex due to increased restrictions placed on broad-spectrum pesticides and the proliferation of narrowly focused pesticide alternatives. As a result, pests once considered minor pests are now achieving major pest status in some areas. For example, in the West, leafrollers and grape mealy bug have become more troublesome as the industry has shifted to mating disruption to control codling moth. Furthermore, use of some of the available alternatives to AZM and phosmet could disrupt predatory insect and mite populations, leading to outbreaks of pests traditionally managed by those predators. These pest outbreaks (e.g., spider mites, aphids, leafminers , etc.) will likely require additional pesticide inputs to control them.

Additionally, many of the alternative pest control insecticides currently available are prone to pests developing resistance to them. Some of the IGRs and synthetic pyrethroids are particularly vulnerable. Having a suite of pest control methods available with several different modes of action is perhaps the best defense against the development of pest resistance. If resistance does develop, input costs will likely increase because an increased number of pesticide applications along with the use of maximum rates is often necessary to achieve acceptable control.

Extending REIs to levels that keeps workers from entering fields for extended periods of time could impact a grower's ability to maintain labor crews throughout the growing season. It also could severely limit the amount of time a labor crew has to complete necessary orchard activities such as hand thinning, tree training, summer pruning, or even hand harvesting. This could impact the grower by forcing him to not achieve the desired results from those activities. If hand thinning is delayed for too long a period of time because of extended REIs, the impact on the fruit could be quite extensive and the grower may also lose his thinning crew to a grower who has more consistent work.

Use of several of the newly registered pest control alternatives could have impacts on apples destined for the export market. Since many of these new active ingredients may not have been previously used in importing countries, these countries would not have established tolerances for residues on tree fruits. These countries could be expected to reject imports of treated fruit showing residues that do not meet their standards or where no standards even exist. Codex pesticide standards used for international trade currently take five to eight years to establish. This delay could result in a long window of time between uses of new insecticides in the US and acceptance by countries using Codex standards. These trade irritant issues are expected to become more difficult for US apple growers as the use of these new insecticides increase.

West Region

Apple Production and Cultural Practices in the West Region

Apple Production in the West -

The West Region is comprised of the apple producing states of the Pacific Northwest (WA, OR, and ID) and Pacific Southwest (CA and AZ) regions. Approximately 56 percent of the bearing acres in the US are located in this region upon which 66 percent of the US apple production is yielded with a value over $932 million. The Pacific Northwest alone accounts for 39 percent of US apple bearing acreage and 55 percent of the value of US production. Table 9 lists apple production in the US and the West Region.

Table 9. Apple Production and the Value of Production in the US and the West Region [1]

US/Region	Bearing Acreage (Acres)	Production (million pounds)	Percent of US Production	Percent of Region Production	Value of Production ($1000)
US	464,500	10,605	–	–	$1,434,394
West Region	220,600	6,611	62%	--	$932,456
Pacific Northwest[2]	180,700	5,694	54%	86%	$796,037
Pacific Southwest[3]	39,900	917	9%	14%	$136,419

1. Source: USDA/NASS Noncitrus Fruits and Nuts 2000 Preliminary Summary.
2. Pacific Northwest includes WA, OR, and ID.
3. Pacific Southwest includes CA and AZ.

Table 10 lists apple production and the value of production by end use market for the US and West Region. As is evident from the information listed in the table, 68 percent of the production in the West Region is destined for the fresh market. The region also accounts for nearly 49 percent of the total US production that is processed. The West Region accounts for 65 percent of the total value of the US apple crop, and 71 percent of the value of the total value of US fresh apple production. There is a significant difference in price paid for apples destined for the fresh market when compared to the price received for processed apples. The value of production in the West Region is approximately $0.19 per pound for fresh production and $0.04 per pound for processed apples.

Table 10. Apple Production and the Value of Production in the US and the West Region by End Use Market [1]

US/Region	Production (million pounds)			Value of Production ($1000)		
	Total	Fresh	Processed	Total	Fresh	Processed
US	10,605	6,204	4,401	$1,434,394	$1,194,278	$390,116
West Region	6,611	4,464	2,148	$932,456	$845,711	$86,745
Pacific Northwest[2]	5,694	4,045	1,650	$796,037	$735,795	$60,242
Pacific Southwest[3]	917	419	498	$136,419	$109,916	$26,503

1. Source: USDA/NASS Noncitrus Fruits and Nuts 2000 Preliminary Summary.
2. Pacific Northwest includes WA, OR, and ID.
3. Pacific Southwest includes CA and AZ.

Apple Cultural Practices in the West Region -

This West Region spans a wide geographic area from North to South and different climates (cool, hot, dry, temperate) are present. With such a wide geographic area covered in this region, there are differences in cultural practices and when during the year the tree, fruit, and pests develop. This is particularly true in CA. In the more southern zone of this region (CA and AZ), the trees and fruit develop earlier in the season because temperatures are warmer than in the northern reaches of the region (WA). Pests also develop earlier in the southern part of this region as well. Considering this, however, there is little difference amongst the various cultural practices growers use to manage their orchards in this region.

Depending on the apple variety grown, petal fall occurs anywhere from early April to mid-May within this region. Approximately 7-14 days following the petal fall application, growers begin cover sprays every 10-21 days until late summer or early fall depending on the product used and pest pressure. The first cover spray, generally from mid-May to early June, is a critical timing when either AZM or phosmet are almost always used. Harvest activities can begin in late July in CA with the earliest maturing varieties and reach a peak in late August through September for the West region.

There are a number of activities that would require workers to enter an orchard during the growing season other than to make pesticide applications. Some of those activities include general maintenance activities that result in little to no foliage or fruit contact, such as mowing between tree rows, to high contact activities, such as hand thinning. Like in the East Region, the primary high contact foliage and fruit contact activities in the West Region include hand thinning, summer pruning, hand harvesting, tree training, and placement of pheromones for mating disruption.

As is the case with all apple acreage in the US, 100 percent of the acreage in the West Region is hand harvested. Hand thinning of fruit is the next most common activity that would require workers to reenter fields following pesticide applications. Approximately 80 to 100 percent of the apple acreage in the West is hand thinned and occurs from mid-May through early July in the West Region. Refer to the discussion of hand thinning under the East Region for details about why fruit thinning is important. Although chemical thinning is used on a large percent of the acreage in the West, nearly every acre receives supplemental hand thinning. Since a larger percentage of the production in the West goes to the fresh market, which receives a premium price, there is a greater emphasis on producing a visually perfect fruit. Therefore, essentially all apple acreage in the West is managed as if it were being produced for the fresh market, hence, such a large percent of the acreage being hand thinned.

The next most common cultural activity in the West Region that results in a generally high amount of foliage contact is summer pruning, which occurs on an estimated 40 to 50 percent of the acreage. The practice of summer pruning is best used in combination with the more common practice of dormant pruning, which occurs during the winter months. Summer pruning helps improve fruit color, alter fruit quality, train trees, and allow better distribution of the labor force. Summer pruning generally occurs from mid-May to early July and coincides with the same time that hand thinning would occur.

A much larger percent of the apple acreage in the West Region is under pheromone mating disruption than in the East. Approximately 50 percent of the acreage in 2000 was under a mating disruption program and the percent of acreage expected to increase in coming years. Workers are in the orchards in April attaching pheromone ties in the tree canopy (results are best when ties are placed within 1 meter of the top of the canopy) prior to emergence of codling moth adult males. Most workers placing pheromone ties would not be exposed to AZM or phosmet residues because this activity occurs prior to the first application of these materials. Occasionally (less than 5% of the acreage), a second application of pheromone dispensers may be necessary during the summer which could potentially result in workers coming in contact with treated foliage and fruit.

Tree training occurs on an estimated 40 to 50 percent of the acreage in the West. As in the East, the amount of tree training that occurs depends on the rootstock used and the orchard layout and design. Please refer to the discussion related to tree training in section

Codling moth (*Cydia pomonella*) is the most important pest of apples in the US and is a primary target for AZM and phosmet applications in the West. AZM receives the most usage against this pest in the West and has been the standard control choice for over 30 years. Codling moth is primarily a feeder within apples that makes the fruit unmarketable. Without effective control, losses can range from 50 to 90% of the crop. There can be as many as five generations in the southern reaches of the West Region, but on average for the region there are probably three. The insect overwinters as a mature larvae with the adult emerging around full bloom. The adult lays eggs on the fruit and when the egg hatches the larva burrows into the apple, creating large tunnels and making the fruit unmarketable. After feeding within the apple for approximately three weeks, the larva emerges and seeks a pupation site. After two to three weeks in the pupal stage, the adult emerges for a second generation. Depending on climatic conditions, the life cycle is repeated several more times. Generations often overlap, which makes applications targeted at controlling the larvae before they enter the fruit particularly difficult to time in order to achieve the level of control necessary. Some populations of codling moth in CA have developed resistance to AZM and phosmet. Some other areas in the West (OR) have recently experienced reduced efficacy from AZM and phosmet applications against codling moth and they suspect that resistance may be the culprit. The pest is present during the time period that hand thinning, tree training, summer pruning, pheromone placement, and hand harvesting activities occur. Countries that receive exports of apples from the US require that they be certified codling moth free.

The grape mealybug (*Pseudococcus maritimus* Ehrhorn) was originally described as a pest of grapes, but it can attack most deciduous fruit crops. Since the 1970's, it has become an increasingly severe pest of apple. It is slow to spread from orchard to orchard, but once an orchard is infested the infestation is difficult to clean up. It is usually only a problem on large, mature trees that are difficult to spray thoroughly and provide shelter for grape mealybug. Mealybugs are pests of concern in some export markets. Grape mealybug may not specifically be identified as a phytosanitary risk, but great difficulty exists in separating quarantine versus non-quarantine species if only immature stages are detected. Grape mealybugs overwinter and emerge as crawlers from before bloom to petal fall. They damage fruit by causing russeting from the honeydew that they produce. Applications to control grape mealybug would occur before or at petal fall and may coincide with pheromone tie placement in trees for mating disruption.

Several species of green fruitworms (*Orthosia hibisci, Amphipyra pyramidoides, Xylomyges curialis*) attack apple and are more common in Pacific Southwest than the Pacific Northwest. All of the above species have one generation per year. They cause similar damage by feeding on young leaves and fruit early in the season, causing the fruit to be misshapen and scarred. Spray programs for other insects generally help reduce populations. When necessary, insecticides are generally applied at petal fall or shortly thereafter to control this pest. These applications could coincide with mating disruption pheromone placement and early hand thinning activities.

Oblique-banded leafroller (*Choristoneura rosaceana* Harris) is one of many types of leafroller species that attack apple. It was described as a pest that also attacks apples grown in the East Region. In the West the oblique-banded leafroller has two to three generations each year. It overwinters on host trees as young larvae and as foliage emerges the larvae often tie leaves to the surface of fruit and feed in t he sheltered area. The oblique-banded leafroller and the another leafroller species, the Pandemis leafroller (*Pandemis pyrusana* Kearfott), are the most important secondary pests in apple orchards, especially where codling moth mating disruption is used and broad-spectrum insecticide use has been reduced. In some areas of the West leafrollers have developed resistance to AZM and phosmet and have become the “key” pest in apple orchards, becoming as or more important than codling moth. In areas where there is not AZM or phosmet resistance, several applications can be applied throughout the growing season. Applications would coincide with worker activities including hand thinning, tree training, summer pruning, and possibly even hand harvesting.

Western tussock moth (*Orgyia vetusta*) has one generation per year and is predominantly found in the Pacific Southwest. They are often present in the orchards at the same time as green fruitworms. A heavy infestation may destroy all spring growth, and in newly planted orchards, a heavy infestation may kill young trees by consuming the buds as they open. Larvae may also take shallow bites out of newly set or young fruit; these injured areas eventually scab over. Larvae rarely feed on mature fruit.

Potential Pest Control Alternatives

Please refer to the earlier discussion under the East Region on potential pest control alternatives

Restricted Entry and Pre-Harvest Intervals

The current label REI for azinphos-methyl is 14 days for hand harvest and hand thinning, and 48 hours for other activities except in areas where average rainfall is less than 25 inches a year then the REI is increased to 72 hours. The PHI is 14-days, or 21-days if the application is more than 1 pound ai per acre.

For phosmet, the current label REI is 1 day and the PHI is 7 days (in Eastern apples, 8 days, if mixed with methomyl). Please refer to the occupational and residential human health risk assessment on the Agency's website (http://www.epa.gov/pesticides/op) for information concerning the worker risks associated with the restricted entry intervals for both azinphos-methyl and phosmet.

Impact of Potential REI Extensions for AZM and Phosmet on Apple Production in the West Region

Please refer to the general discussion regarding impacts under the section entitled 'Impact of REI Extensions for AZM and Phosmet on Crop Production in the East Region' for details about how we derived our estimates. Once again, the hypothetical scenarios that BEAD used to assess the potential impacts are listed below.

- Scenario 1 - Azinphos-methyl REI >14 days, and phosmet REI less than or equal to 3 days. Azinphos-methyl would no longer be used by growers.
- Scenario 2 - Azinphos-methyl REI equal to 14 days, and phosmet REI >3 days. Phosmet would no longer be used by growers.
- Scenario 3 - Azinphos-methyl REI >14 days, and phosmet REI >3 days. Both azinphos-methyl and phosmet would no longer be used by growers.
- Scenario 4 - One application of azinphos-methyl at an REI equal to 14 days, and phosmet REI less than or equal to 3 days.

Studies that have assessed grower- and regional-level impacts based on modifying a registered pesticide's use pattern, in this case by extending post-application REIs, were not available for our use. Therefore, for each scenario BEAD has made various assumptions and predictions on grower choices of alternate pest control methods if necessary. Based on available information, BEAD has also estimated changes in fruit yield and/or quality based on the changes in the pest control programs. The basis for our assumptions and predictions are based in large part on discussions and information collected from knowledgeable experts who work in apple pest management, publically available information, and our best professional judgement. We have attempted to quantify as much of the impacts as possible; however, there are certain components that can only be discussed qualitatively. For that reason the impacts associated with each region and the four scenarios will be presented in two sections, Quantitative Impacts and Qualitative Impacts. The quantitative impacts section will contain dollar estimates associated with use pattern changes for AZM and phosmet based on extending the REIs, yield loss estimates, quality loss estimates, and use of alternative pest control methods if necessary. The section on qualitative impacts will discuss broader issues that for purposes of this analysis were unquantifiable, but no less important.

Quantitative Impacts -

Currently in the West Region, on average, AZM is applied three times per season and phosmet is applied two times per season.

- Scenario 1 - Azinphos-methyl REI >14 days, and phosmet REI less than or equal to 3 days. Azinphos-methyl would no longer be used by growers.

    Assumptions -
    1. Alternative Pest Control Program -
        a. 3 additional applications of phosmet (5 apps. total of phosmet on avg./yr)
        b. 2 applications of methoxyfenozide for supplemental codling moth and leafroller control
        c. 25% more acres would use pheromone mating disruption for codling moth (75% of acres would now be using mating disruption) and all acres would use the full rate (current acres being treated with mating disruption, on average, use ½ rate)
    2. 1% Yield Loss -

    a. Rationale - alternative control programs may not provide equivalent efficacy and outbreaks of secondary pests could occur
3. Potential quality loss of 3 to 5% (3 to 5% of production will shift from sale on fresh market to process market; 3 to 5% of production will shift from sale on process market to no sale) -
    a. Rationale - Because alternative pest controls have reduced efficacy compared to AZM, would need to be applied more frequently, and critical pest control windows may be missed resulting in damaged fruit and/or insect contamination in harvested fruit.

- Scenario 2 - Azinphos-methyl REI equal to 14 days, and phosmet REI >3 days. Phosmet would no longer be used by growers.

  Assumptions -
  1. Alternative Pest Control Program -
      a. 2 additional applications of AZM (5 apps. total of AZM on avg./yr)
      b. 1 application for methoxyfenozide because of its shorter REI (4 hours) to not interrupt hand thinning activities
      c. 25% more acres would use pheromone mating disruption for codling moth (75% of acres would now be using mating disruption) and all acres would use the full rate (current acres being treated with mating disruption, on average, use ½ rate)
  2. No yield loss -
      a. Rationale - Assumed alternative pest controls would not reduce yields.
  3. 2% Quality loss (2% of production will shift from sale on fresh market to process market; 2% of production will shift from sale on process market to no sale) -
      a. Rationale - Because alternative pest controls would need to be applied more frequently and critical pest control windows may be missed resulting in damaged fruit and/or insect contamination in harvested fruit.

- Scenario 3 - Azinphos-methyl REI >14 days, and phosmet REI >3 days. Both azinphos-methyl and phosmet would no longer be used by growers.

  Assumptions - There is a potential for two different spray programs to be adopted, depending on the availability of compounds in a particular state or region. For example, methoxyfenozide is not registered in CA, so they would not likely choose spray program 1.
  1. Alternative Pest Control Program 1 (SP1) -
      a. 3 applications of methoxyfenozide (not registered in CA) for codling moth, grape mealybug, and leafrollers
      b. 1 application of tebufenozide because of its short REI and for control of codling moth, green fruitworm, and leafrollers
      c. 1 application of spinosad because of its short PHI and for late season codling moth control
      d. 25% more acres would use pheromone mating disruption for codling moth (75% of acres would now be using mating disruption) and all acres would use the full rate (current acres being treated with mating disruption, on average, use ½ rate)
  2. Alternative Pest Control Program 2 (SP2) -
      a. 3 applications of esfenvalerate for codling moth, leafrollers, green fruitworm, and western tussock moth
      b. 1 application of tebufenozide because of its short REI and for control of codling moth, green fruitworm, and leafrollers
      c. 1 to 3 additional miticide (abamectin or pyridaben) applications because use of pyrethroids will disrupt biological control
      d. 1-2 applications of imidacloprid for aphids and leafminers because use of pyrethroids will disrupt biological control
      e. 1 application of *Bt* for leafrollers
      f. 1 application of spinosad because of its short PHI and for late season codling moth control
      g. 25% more acres would use pheromone mating disruption for codling moth (75% of acres would now be using mating disruption) and all acres would use the full rate (current acres being treated with mating disruption, on average, use ½ rate)
  3. 1% Yield Loss regardless of spray program used

a. Rationale - alternative control programs would not provide equivalent efficacy and outbreaks of secondary pests could occur
4. 5 to 7% Quality loss - 5 to 7% of production will shift from sale on fresh market to process market; 5 to 7% of production will shift from sale on process market to no sale
    a. Rationale - alternative pest controls would need to be applied more frequently and critical pest control windows may be missed resulting in damaged fruit and/or insect contamination in harvested fruit.
    b. Rationale - secondary pests could cause damage that reduce quality.

- Scenario 4 - One application of azinphos-methyl at an REI equal to 14 days, and phosmet REI less than or equal to 3 days.

    Assumptions -
    1. Alternative Pest Control Program -
        a. 2 additional applications of phosmet (4 total apps. of phosmet on avg./yr)
        b. 25% more acres would use pheromone mating disruption for codling moth (75% of acres would now be using mating disruption) and all acres would use the full rate (current acres being treated with mating disruption, on average, use ½ rate)
    2. No Yield Loss
    3. 1% Quality Loss - 1% of production will shift from sale on fresh market to process market; 1% of production will shift from sale on process market to no sale
        a. Rationale - alternative pest controls would need to be applied more frequently and critical pest control windows may be missed resulting in damaged fruit and/or insect contamination in harvested fruit.

Grower Level Impacts

Table 12 lists the impacts at the grower level of changing the REIs of azinphos-methyl and phosmet on apples in the West Region. The impacts of four potential scenarios are estimated. Each scenario represents a different set of REIs for azinphos-methyl and phosmet. Impacts are expected to be different depending on the scenario. The first row lists the current yield, prices, revenues, costs, and net revenues for apples in the West Region. The second through fifth rows list the estimate of impacts of changing the REIs of azinphos-methyl and phosmet as defined in each scenario. The net loss estimate (bolded) in the last column of each scenario is the difference between current net revenues and the estimated net revenues expected as a result of each scenario. (Please see General Assumptions section for a more complete discussion of the impacts.)

- The estimated impact of not having azinphos-methyl available for use on apples in the West Region (scenario 1) is a reduction in grower net revenues to -$122 to $66 per acre, which is a decline of 3/4 to 1 ½ times current net revenues ($271 per acre).

- The estimated impact of not having phosmet available for use on apples in the West Region (scenario 2) is a reduction in grower net revenues to $65 to $185 per acre, which is a decline of 32% to 76% from current net revenues ($271 per acre).

- The estimated impact of not having azinphos-methyl or phosmet available for use on apples in the West Region (scenario 3) is a reduction in grower net revenues to -$342 to $14 per acre (depending on the spray program), which is a decline of 1 to 2 ½ times current net revenues ($271 per acre).

- The estimated impact of only having azinphos-methyl available for 1 application on apples (scenario 4) is a reduction in grower net revenues to $171 to $231 per acre, which is a decline of 15% to 37% from current net revenues ($271 per acre).
-

Table 12. West Region Grower Level Impacts Summary

Scenario	Yield	Quality Impact (Price)	Revenues	Costs	Net Revenues
Current Situation	Current total: 30,092 lbs/A Fr: 20,462 lbs/A Proc: 9,630 lbs/A	Prices: Fr: $0.19/ton Proc: $0.04/ton	Current: $4,275/A	Current: $4,004/A	Current: $271/A
1 REIs: AZM : >14 days Phosmet: =/<3 days	Yield loss: 1% Reduces Yield to: Total: 29,257 lbs/A Fr: 20,257 lbs/A Proc: 9,532 lbs/A	Quality Change: 3-5% Fr: 19,244-19,649 lbs/A Proc: 9,854-10,068 lbs/A No Sale: 286-477 lbs/A	Change to: $4,059/A to $4,127/A	Change to: $4,061/A to $4181/A	Change to: -$122/A to $66/A **Net Loss:** $205/A to $393/A
2 REIs: AZM : =/<14 days Phosmet: >3 days	Yield loss: None	Quality Change: 2% Fr: 20,053 lbs/A Proc: 9,846 lbs/A No Sale: 193 lbs/A	Change to: $4,204/A	Change to: $4,019/A to $4,139/A	Change to: $65/A to $185/A **Net Loss:** $86/A to $206/A
3 REIs: AZM : >14 days Phosmet: >3 days	Yield loss: 1% Reduces Yield to: Total: 29,257 lbs/A Fr: 20,257 lbs/A Proc: 9,532 lbs/A	Quality Change: 5-7% Fr: 18,839-19,244 lbs/A Proc: 10,068-10,283 lbs/A No Sale: 477-667 lbs/A	Change to: $3,990/A to $4,059/A	Change to: SP 1: $4,045/A to $4,165/A SP 2: $4,090/A to $4,332/A	Change to: SP 1: -$175 to $14/A SP 2: -$31 to - $342/A **Net Loss:** SP 1: $257/A to $446/A SP 2: $302/A to $613/A
4 REIs: AZM : =/<14 days, 1 app. Phosmet: =/<3 days	Yield loss: None	Quality Change: 1% Fr: 20,257 lbs/A Proc: 9,739 lbs/A No Sale: 96 lbs/A	Change to: $4,239/A	Change to: $4,008/A to $4,068/A	Change to: $171/A to $231/A **Net Loss:** $40/A to $100/A

SP 1 refers to spray program 1 and SP 2 refers to spray program 2.
See General Assumptions section for a more complete discussion of the impacts.

Regional Level Impacts

Table 13 lists the impacts at the regional level of changing the REIs of azinphos-methyl and phosmet on apples in the West Region. The impacts of four potential scenarios are estimated. Each scenario represents a different set of REIs for azinphos-methyl and phosmet. Impacts are expected to be different depending on the scenario. Under each scenario, current and estimated net revenues are listed for the West Region and the two smaller regions (i.e., Pacific North and Pacific South Regions) comprising the West Region. (Please see General Assumptions section for a more complete discussion of the impacts.)

on the East Region. Workers conducting tree training activities could be in the orchard any time from mid-May through early August in the West Region.

Azinphos-methyl and Phosmet Usage and Target Pests in the West Region

Azinphos-methyl and Phosmet Usage -

AZM and phosmet are both used in the West Region; however, AZM is used with much greater frequency than phosmet. There may be as many as 12 applications of azinphos-methyl and phosmet throughout the season, but on average there are 2 phosmet and 3 azinphos-methyl applications. Average rates per application for phosmet are around 2.0 pounds active ingredient per acre, and for azinphos-methyl 1.0 pound active ingredient per acre. Table 11 list the usage of azinphos-methyl and phosmet on apples in the US and the West Region. On average, more than 75% of the US and the West apple bearing acreage is treated with azinphos methyl per year, with 84 percent of the Pacific Northwest acreage treated. Nearly 25% of the US apple bearing acreage is treated with phosmet, but only 10 percent of the West acreage is treated. The Pacific Southwest portion of the West treats 36 percent of their acreage with phosmet per year.

Table 11. Usage of Azinphos-methyl and Phosmet Usage on US and the West Apples [1]

US/Region	Percent of Crop Treated	Base Acres Treated (1000 acres) [2]	Rates (lbs. ai/Acre)	Average # of Applications/Yr	Total Pounds Applied (1000 lbs)
Azinphos-methyl Usage					
US	78%	362	0.7	3	636
West	76%	168	1.0	3	400
Pacific Northwest[3]	84%	152	1.0	3	369
Pacific Southwest[4]	39%	16	1.0	2	31
Phosmet Usage					
US	24%	112	1.4	2	267
West	10%	23	2.0 - 2.3	2	78
Pacific Northwest[3]	5%	9	2.0	2	28
Pacific Southwest[4]	36%	14	2.3	2	50

1. Source: USDA/NASS Fruit and Nut Chemical Use, 1997 and 1999.
2. Base acres treated calculated using percent of crop treated estimates and bearing acreage from Table 1.
3. Pacific Northwest includes WA, OR, and ID.
4. Pacific Southwest includes CA and AZ.

Target Pests -

There are fewer insect pests that attack apples in the West Region than in the East Region. In particular, the West does not currently have plum curculio or significant populations of apple maggot. The primary pest that drives the use of AZM and phosmet in the West is codling moth. Grape mealybug, green fruitworm, oblique-banded leafroller, and Western tussock moth are also targeted with applications of either AZM or phosmet; however, these pests occur with much less frequency when compared to codling moth.

- The estimated impact of not having azinphos-methyl available for use on apples in the West Region (scenario 1) is a reduction in regional net revenues of as much as 1 1/4 times current net revenues in the West Region and the two regions comprising the West Region.
- The estimated impact of not having phosmet available for use on apples in the West Region (scenario 2) is a reduction in regional net revenues of as much as 28% from current net revenues in the West Region and the two regions comprising the West Region.
- The estimated impact of not having azinphos-methyl and phosmet available for use on apples in the West Region (scenario 3) is a reduction in regional net revenues of as much as 1 3/4 times current net revenues in the West Region and the two regions comprising the West Region.
- The estimated impact of having azinphos-methyl available for only 1 application on apples in the West Region (scenario 4) is a reduction in regional net revenues of as much as 47% from current net revenues in the West Region and the two regions comprising the West Region.

Table 13. West Region Regional Level Impacts

Scenario	Region	Net Revenues
1 REIs: AZM: > 14 days Phosmet: =/<3 days	West	Current Total: $59.8 million New Total: -$6 million to $25.4 million Net Loss: $34.4 million to $65.8 million
	Pacific North	Current Total: $49 million New Total: -$10.7 million to $17.8 million Net Loss: $31.2 million to $59.7 million
	Pacific South	Current Total: $10.8 million New Total: $4.7 million to $7.6 million Net Loss: $3.2 million to $6.1 million
2 REIs: AZM: =/<14 days Phosmet: >3 days	West	Current Total: $59.8 million New Total: $54.9 million to $57.7 million Net Loss: $2.1 million to $4.9 million
	Pacific North	Current Total: $49 million New Total: $47.1 million to $48.2 million Net Loss: $0.8 million to $1.9 million
	Pacific South	Current Total: $10.8 million New Total: $7.8 million to $9.5 million Net Loss: $1.3 million to $3 million
3 REIs: AZM: > 14 days Phosmet: > 3 days	West	Current Total: $59.8 million SP1: New Total: -$15 million to $16.6 million Net Loss: $43.2 million to $74.8 million SP2: New Total: -$43 million to $9.1 million Net Loss: $50.7 million to $102.8 million
	Pacific North	Current Total: $49 million New Total: -$18.8million to $9.9 million Net Loss: $39.1 million to $67.8 million
	Pacific South	Current Total: $10.8 million New Total: $1.3 million to $6.1 million Net Loss: $4.2 million to $9.5 million
4 REIs: AZM: =/< 14 days, 1 application Phosmet: =/<3 days	West	Current Total:$59.8 million New Total: $43.1 million to $53.1 million Net Loss: $6.7 million to $16.7 million
	Pacific North	Current Total: $49 million New Total: $33.8 million to $42.9 million Net Loss: $6.1 million to $15.2 million
	Pacific South	Current Total: $10.8 million New Total: $9.3 million to $10.2 million Net Loss: $0.6 million to $1.5 million

SP 1 refers to spray program 1 and SP 2 refers to spray program 2.

See General Assumptions section for a more complete discussion of the impacts.

Qualitative Impacts -

Please refer to the section on qualitative impacts under the Impact of Potential REI Extensions for AZM and Phosmet on Apple Production in the East Region.

National Level Impacts

Table 14 lists the impacts at the national level of changing the REIs of azinphos-methyl and phosmet on apples in the West Region. The impacts of four potential scenarios are estimated. Each scenario represents a different set of REIs for azinphos-methyl and phosmet. Impacts are expected to be different depending on the scenario. Under each scenario, current and estimated net revenues are listed at the National Level the two regions (i.e., East and West Regions) comprising the U.S. (Please see General Assumptions section for a more complete discussion of the impacts.)

- The estimated impact of not having azinphos-methyl available for use on apples at the national level (scenario 1) is a reduction in national net revenues of as much as 100% from current national net revenues.

- The estimated impact of not having phosmet available for use on apples at the national level (scenario 2) is a reduction in national net revenues of as much as 11% from current national net revenues.

- The estimated impact of not having azinphos-methyl and phosmet available for use on apples at the national level (scenario 3) is a reduction in national net revenues of as much as 2 times current national net revenues.

- The estimated impact of having azinphos-methyl available for only 1 application on apples at the national level (scenario 4) is a reduction in national net revenues of as much as 30% from current national net revenues.

Table 14. National Level Impacts Summary

Scenario	Region	Net Revenues
1 REIs: AZM: >14 days Phosmet: =/<3 days	US	Current Total: $83.1 million New Total: -$1.55 million to $33.85 million Net Loss: $49.25 million to $84.65 million
	East	Current Total: $23.3 million New Total: $4.45 million Net Loss: $18.85 million
	West	Current Total: $59.8 million New Total: -$6 million to $29.4 million Net Loss: $34.4 million to $65.8 million
2 REIs: AZM: =/<14 days Phosmet: >3 days	US	Current Total: $83.1 million New Total: $73.6 million to $76.4 million Net Loss: $6.7 million to $9.5 million
	East	Current Total: $23.3 million New Total: $18.7 million Net Loss: $4.6 million

Scenario	Region	Net Revenues
	West	Current Total: $59.8 million New Total: $54.9 million to $57.7 million Net Loss: $2.1 million to $4.9 million
3 REIs: AZM: >14 days Phosmet: >3 days	US	Current Total: $83.1 million SP1: New Total: -$24.3 million to $7.3 million Net Loss: $70.7 million to $107.4 million SP2: New Total: -$74.1 million to $5.1 million Net Loss: $78 million to $157.2 million
	East	Current Total: $23.3 million SP1: New Total: -$4.2 million to -$9.3 million Net Loss: $27.5 million to $32.6 million SP2: New Total: -$4 million to -$31.1 million Net Loss: $27.3 million to $54.4 million
	West	Current Total: $59.8 million SP1: New Total: -$15 million to $16.6 million Net Loss: $43.2 million to $74.8 million SP2: New Total: -$43 million to $9.1 million Net Loss: $50.7 million to $102.8 million
4 REIs: AZM: =/<14 days, 1 app. Phosmet: =/<3 days	US	Current Total: $83.1 million New Total: $58 million to $68 million Net Loss: $15.1 million to $25.1 million
	East	Current Total: $23.3 million New Total: $14.9 million Net Loss: $8.4 million
	West	Current Total: $59.8 million New Total: $43.1 million to $53.1 million Net Loss: $6.7 million to $16.7 million

SP 1 refers to spray program 1 and SP 2 refers to spray program 2.
See General Assumptions section for a more complete discussion of the impacts.

Appendix A

General Assumptions for Quantitative Analysis

Assumptions

The following is a description of the assumptions made to calculate the impacts on apple grower revenues (yield and price), costs, and net revenues (profits) of extending the restricted entry intervals (REIs) for phosmet and azinphos-methyl on apples, and of the estimates of apple grower revenues, costs, and net revenues as a result of extending the REIs for phosmet and azinphos-methyl on apples. For a discussion of the factors considered and the calculations performed for this benefits assessment, see the section on benefits factors and calculations.

Impacts are estimated for four scenarios as defined below. Each scenario represents a different combination of phosmet and azinphos-methyl REIs, with the assumption made that for any REI longer than 3 days for phosmet, and longer than 14 days for azinphos-methyl, apple growers will suffer impacts to their revenues received and/or costs of production. Impacts are measured in terms of the effect of changing azinphos-methyl and phosmet REIs (as set out in each scenario) on per acre grower revenues, costs, and net revenues. The grower level estimates of net revenues are aggregated up to a regional and national level, taking into account apple acres grown and apple acres treated with azinphos-methyl and phosmet (depending on the scenario) in each region.

The estimates impacts to yield, price, and cost were assumed based on the available information. The analysis is limited to changes in yield, price, and quality for the general categories of fresh and processed apples only - not by grade and variety of apple. The estimates of current production, yield, and price are based on production and price data published in USDA's Noncitrus Fruits and Nuts 2000 Preliminary Summary. The estimates of total, variable, and fixed costs are based on apple enterprise budgets for states within each region. For the East Region, the costs are an average of Pennsylvania and Northeast, and for the West Region, the costs are an average of Washington and California budgets.

Assumptions and estimated impacts are provided by Region (i.e., East and West) and by scenario, with separate sections for grower and regional level impacts. The regional level impacts are estimated for the smaller regions making up the East Region (i.e., the New England, Appalachian/Southern, and North Central Regions) and West Region (i.e., the Pacific North and Pacific South Regions). An estimate of national level impacts is provided as well. At the end of both the grower and regional level impact sections for the East and West Regions is a table summarizing the grower and regional level impacts, respectively. Following the summary of the West Region regional level impacts is a summary of national level impacts.

<u>East Region</u>

Grower Level Impacts
Assume if a grower uses azinphos-methyl and phosmet, the grower uses azinphos-methyl and phosmet on every acre grown.

SCENARIO 1
Azinphos-methyl REI >14 days, and phosmet REI/PHI less than or equal to 3 days. Azinphos-methyl would no longer be used by growers.

1. Revenue Impact:
Revenues are impacted through changes in yield and in quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold. The potential changes to yield and quality are as follows:

A. Assume in the East produce 17,720 pounds of apples per acre, with a value of $2,090 per acre. This assumes 7,090 pounds per acre (40%) is destined for the fresh market (at a price of $0.19 per pound), and 10,630 pounds per acre (60%) is destined for the processed market (at a price of $0.07 per pound). This also assumes that fresh export and fresh domestic apples receive the same price per pound.

B. Assume no loss in yield without azinphos-methyl available.

C. Assume a reduction in the quality (size and color) of the apples produced as a result of damaged caused by an increase in insect presence on the fruit with alternative chemical control. This could potentially lead to a change in the end use market for the apples (i.e., fresh export, fresh domestic, processed, or no sale) and, therefore, the price received for production.

Assume the price received by growers for fresh market apples is equal to $0.19 per pound, and for processed market apples, $0.07 per pound. Also assume the potential change in price received for production is equal to $0 per pound (no change in end use market to $0.12 per ton (change from fresh market to processed market)).

Assume a 3% reduction in the quality (end use market) of the apples produced. Assume 3% of the current fresh apple production per acre goes to the processed market, and 3% of the current processed apple production per acre is not sold. Production destined for the fresh market declines to 6,877 pounds per acre, and production destined for the processed market declines to 10,524 pounds per acre. The remaining 319 pounds per acre produced is not sold.

D. Assume the value of the fresh market production declines to $1,307 per acre (6,877 pounds per acre at $0.19 per pound) and the value of processed market production declines to $737 per acre (10,524 pounds at $0.07 per pound). Revenues would equal $2,044 per acre - a decline of 2% from current per acre revenues of $2,090 per acre.

2. Cost Impact

A. Assume costs could be as much as $1,976 per acre ($1,386 variable costs, and $590 fixed costs).

B. Assume fixed costs are unchanged.

C. Assume a change in variable costs due to additional insecticide control to replace the average of 3 applications of azinphos-methyl.

1. Assume 4 additional applications of phosmet for the control of target pests. Additional cost of $21 per acre.

2. Assume 1 additional application of *Bt* and 1 additional application of spinosad for control of leafroller. Additional cost of $48 per acre.

D. Assume variable costs increase $69 per acre to $1,455 per acre.

E. Assume total costs increase from $1,976 per acre to $2,045 per acre - an increase of 3%.

3. Net Revenue (Profit) Impacts

Per Acre

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre.

B. Assume revenues decline to $2,044 per acre, and costs increase to $2,045 per acre. Net revenues equal -$1 per acre - a decline of more than 100% from current per acre net revenues.

Per Farm

C. Assume that total current farm profits equal $2,052 (an average of 18 acres per farm at profits of $114 per acre) in the East Region from apple production.

D. Assume per farm profits of -$18 - a decline of more than 100% in per farm profits with the loss of azinphos-methyl for apple production in the East Region.

SCENARIO 2

Azinphos-methyl REI equal to 14 days, and phosmet REI/PHI >3 days. Phosmet would no longer be used by growers.

1. Revenue Impact:
Revenues are impacted through changes in yield and in quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold. The potential changes to yield and quality are as follows:

A. Assume in the East produce 17,720 pounds of apples per acre, with a value of $2,090 per acre. This assumes 7,090 pounds per acre (40%) is destined for the fresh market (at a price of $0.19 per pound), and 10,630 pounds per acre (60%) is destined for the processed market (at a price of $0.07 per pound). This also assumes that fresh export and fresh domestic apples receive the same price per pound.

B. Assume no loss in yield without phosmet available.

C. Assume a reduction in the quality (size and color) of the apples produced as a result of damaged caused by an increase in insect presence on the fruit with alternative chemical control. This could potentially lead to a change in the end use market for the apples (i.e., fresh export, fresh domestic, processed, or no sale) and, therefore, the price received for production.

Assume the price received by growers for fresh market apples is equal to $0.19 per pound, and for processed market apples, $0.07 per pound. Also assume the potential change in price received for production is equal to $0 per pound (no change in end use market to $0.12 per ton (change from fresh market to processed market)).

Assume a 3% reduction in the quality (end use market) of the apples produced. Assume 3% of the current fresh apple production per acre goes to the processed market, and 3% of the current processed apple production per acre is not sold. Production destined for the fresh market declines to 6,877 pounds per acre, and production destined for the processed market declines to 10,524 pounds per acre. The remaining 319 pounds per acre produced is not sold.

D. Assume the value of the fresh market production declines to $1,307 per acre (6,877 pounds per acre at $0.19 per pound) and the value of processed market production declines to $737 per acre (10,524 pounds at $0.07 per pound). Revenues would equal $2,044 per acre - a decline of 2% from current per acre revenues of $2,090 per acre.

2. Cost Impact

A. Assume costs could be as much as $1,976 per acre ($1,386 variable costs, and $590 fixed costs).

B. Assume fixed costs are unchanged.

C. Assume a change in variable costs due to additional insecticide control to replace the average of 3 applications of phosmet.

1. Assume 2 additional applications of azinphos-methyl for the control of target pests. Because phosmet is more expensive than azinphos-methyl, this is a savings of $19 per acre.

2. Assume 1 additional application of tebufenozide for codling moth control during hand thinning activities due to its shorter REI than azinphos-methyl. Additional cost of $19 per acre.

2. Assume 1 additional application of a synthetic pyrethroid (i.e., esfenvalerate) for late season apple maggot control. Additional cost of $6 per acre.

D. Assume variable costs increase $6 per acre to $1,392 per acre.

E. Assume total costs increase from $1,976 per acre to $1,982 per acre - an increase of 1%.

3. Net Revenue (Profit) Impacts

Per Acre

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre.

B. Assume revenues decline to $2,044 per acre, and costs increase to $1,982 per acre. Net revenues equal $62 per acre - a decline of 46% from current per acre net revenues.

Per Farm

C. Assume that total current farm profits equal $2,052 (an average of 18 acres per farm at profits of $114 per acre) in the East Region from apple production.

D. Assume per farm profits of $1,116 - a decline of 46% in per farm profits with the loss of phosmet for apple production in the East Region.

SCENARIO 3

Azinphos-methyl REI >14 days, and phosmet REI/PHI >3 days. Azinphos-methyl and phosmet would no longer be used by growers.

1. Revenue Impact:

Revenues are impacted through changes in yield and in quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold. The potential changes to yield and quality are as follows:

A. Assume in the East produce 17,720 pounds of apples per acre, with a value of $2,090 per acre. This assumes 7,090 pounds per acre (40%) is destined for the fresh market (at a price of $0.19 per pound), and 10,630 pounds per acre (60%) is destined for the processed market (at a price of $0.07 per pound). This also assumes that fresh export and fresh domestic apples receive the same price per pound.

B. Assume a yield loss of 1% due to lack of effective alternative control of target pests. On a per acre level, a 1% loss in yield equates to a reduction in production of 177 pounds per acre, reducing yield to 17,543 pounds per acre. Production destined for the fresh market would equal 7,017 pounds per acre (40% of total production), and production destined for the processed market would equal 10,526 per acre (60% of total production).

C. Assume a reduction in the quality (size and color) of the apples produced as a result of damaged caused by an increase in insect presence on the fruit with alternative chemical control. This could potentially lead to a change in the end use market for the apples (i.e., fresh export, fresh domestic, processed, or no sale) and, therefore, the price received for production.

Assume the price received by growers for fresh market apples is equal to $0.19 per pound, and for processed market apples, $0.07 per pound. Also assume the potential change in price received for production is equal to $0 per pound (no change in end use market to $0.12 per ton (change from fresh market to processed market)).

Assume a 3% to 5% reduction in the quality (end use market) of the apples produced. Assume 3% to 5% of the current fresh apple production per acre goes to the processed market, and 3% to 5% of the current processed apple production per acre is not sold. Production destined for the fresh market declines to 6,666 to 6,807 pounds per acre, and production destined for the processed market declines to 10,000 to 10,210 pounds per acre. The remaining 316 to 524 pounds per acre produced is not sold.

D. Assume the value of the fresh market production declines to $1,266 to $1,293 per acre, and the value of processed market production declines to $725 to $729 per acre. Revenues would equal $1,991 (5% yield loss) to $2,022 (3% yield loss) per acre - a decline of 3% to 5% from current per acre revenues of $2,090 per acre.

2. Cost Impact

A. Assume costs could be as much as $1,976 per acre ($1,386 variable costs, and $590 fixed costs).

B. Assume fixed costs are unchanged.

C. Assume a change in variable costs due to additional insecticide control to replace the average of 3 applications of azinphos-methyl and 3 applications of phosmet. There is a potential for two different spray programs to be adopted, depending on the availability of compounds in a particular state or region. For example, methoxyfenozide is not registered in New York, so they would not likely choose spray program 1.

1. Spray Program 1

A. Assume an additional 3 applications of methoxyfenozide, 1 application of tebufenozide, 2 applications of thiamethoxam, 2 applications indoxacarb, and 1 application of spinosad for the control of target pests. Cost (assuming the cost of methoxyfenozide and thiamethoxam the same as tebufenozide) of $185 per acre.

B. Assume an increase in variable costs of $101 per acre (current cost of azinphos-methyl and phosmet applications totals $84 per acre).

2. Spray program 2

A. Assume 4-6 applications of synthetic pyrethroids (i.e., 2-3 esfenvalerate and 1-2 permethrin), and two applications of indoxacarb for the control of target pests. Cost of $64 to $78 per acre.

B. Assume additional applications of chemicals for the control of secondary pest outbreaks from the use of synthetic pyrethroids.

1. Assume 1-3 additional application of miticides (abamectin or pyridaben) at a cost of $52 to $156 per acre.

2. Assume 1-2 additional applications of imidacloprid for aphid and leafminer at a cost of $18 to $36 per acre.

3. Assume 1 additional application of *Bt* and 1 additional application of spinosad for control of leafroller at cost of $48 per acre.

C. Assume a cost of primary and secondary pest control of $144 to $280 per acre.

D. Assume an increase in variable costs of $98 to $234 per acre (current cost of azinphos-methyl and phosmet applications totals $84 per acre).

D. Assume, under spray program 1, total costs increase from $1,976 per acre to $2,077 per acre - an increase of 5%; and under spray program 2, total costs increase from $1,976 to $2,074 to $2,210 per acre - an increase of 5% to 12%.

3. Net Revenue (Profit) Impacts

Per Acre

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre.

B. Assume revenues decline to $1,991 to $2,022 per acre, and, under spray program 1, costs increase to $2,077 per acre. Net revenues equal -$55 to -$86 per acre - a decline of 1 ½ to 1 3/4 times current net revenues.

Assume revenues decline to $1,991 to $2,022 per acre, and, under spray program 2, costs increase to $2,074 to $2,210 per acre. Net revenues equal -$52 to -$219 per acre - a decline of more than 1 ½ to 3 times current net revenues.

Per Farm

C. Assume that total current farm profits equal $2,052 (an average of 18 acres per farm at profits of $114 per acre) in the East Region from apple production.

D. Assume, under spray program 1, per farm profits of -$990 to -$1,548 - a decline of 1 ½ to 1 3/4 times current net revenues; and, under spray program 2, per farm profits of -$936 to -$3,942 - a decline of more than 1½ to 3 times current net revenues, with the loss of azinphos-methyl and phosmet for apple production in the East Region.

SCENARIO 4

One application of azinphos-methyl at an REI equal to 14 days, and phosmet REI/PHI less than or equal to 3 days.

1. Revenue Impact:

Revenues are impacted through changes in yield and in quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold. The potential changes to yield and quality are as follows:

A. Assume in the East produce 17,720 pounds of apples per acre, with a value of $2,090 per acre. This assumes 7,090 pounds per acre (40%) is destined for the fresh market (at a price of $0.19 per pound), and 10,630 pounds per acre (60%) is destined for the processed market (at a price of $0.07 per pound). This also assumes that fresh export and fresh domestic apples receive the same price per pound.

B. Assume no loss in yield with only one application of azinphos-methyl available for the production of apples.

C. Assume a reduction in the quality (size and color) of the apples produced as a result of damaged caused by an increase in insect presence on the fruit with alternative chemical control. This could potentially lead to a change in the end use market for the apples (i.e., fresh export, fresh domestic, processed, or no sale) and, therefore, the price received for production.

Assume the price received by growers for fresh market apples is equal to $0.19 per pound, and for processed market apples, $0.07 per pound. Also assume the potential change in price received for production is equal to $0 per pound (no change in end use market to $0.12 per ton (change from fresh market to processed market)).

Assume a 1% reduction in the quality (end use market) of the apples produced. Assume 1% of the current fresh apple production per acre goes to the processed market, and 1% of the current processed apple production per acre is not sold. Production destined for the fresh market declines to 7,019 pounds per acre, and production destined for the processed market declines to 10,595 per acre. The remaining 106 pounds per acre produced is not sold.

D. Assume the value of the fresh market production declines to $1,334 per acre (7,019 pounds per acre at $0.19 per pound) and the value of processed market production declines to $742 per acre (10,595 pounds at $0.07 per pound). Revenues would equal $2,076 per acre - a decline of 1% from current per acre revenues of $2,090 per acre.

2. Cost Impact

A. Assume costs could be as much as $1,976 per acre ($1,386 variable costs, and $590 fixed costs).

B. Assume fixed costs are unchanged.

C. Assume a change in variable costs due to additional insecticide control to replace the average of 2 applications of azinphos-methyl.

1. Assume 2 additional applications of phosmet for the control of target pests. Additional cost of $4 per acre.

2. Assume 1 additional application of spinosad for control of leafroller. Additional cost of $33 per acre.

D. Assume variable costs increase $37 per acre to $1,423 per acre.

E. Assume total costs increase from $1,976 per acre to $2,013 per acre - an increase of 2%.

3. Net Revenue (Profit) Impacts

Per Acre

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre.

B. Assume revenues decline to $2,076 per acre, and costs increase to $2,013 per acre. Net revenues equal $63 per acre - a decline of 45% from current per acre net revenues.

Per Farm

C. Assume that total current farm profits equal $2,052 (an average of 18 acres per farm at profits of $114 per acre) in the East Region from apple production.

D. Assume per farm profits of $1,134 - a decline of 45% in per farm profits with phosmet available at an REI of less than or equal to 3 days, and azinphos-methyl available for 1 application at a 14 day REI.

East Region Grower Level Impacts Summary

Scenario	Yield	Quality Impact (Price)	Revenues	Costs	Net Revenues
Current Situation	Current total: 17,720 lbs/A Fr: 7,090 lbs/A Proc: 10,630 lbs/A	Prices: Fr: $0.19/lb Proc: $0.07/lb	Current: $2,090/A	Current: $1,976/A	Current: $114/A
1 REIs: AZM : >14 days Phosmet: =/<3 days	Yield loss: None	Quality Change: 3% Total: 17,720 lbs/A Fr: 6,877 lbs/A Proc: 10,524 lbs/A No sale: 319 lbs/A	Change to: $2,044/A	Change to: $2,045/A	Change to: -$1/A **Net Loss:** $115/A
2 REIs: AZM : =/<14 days Phosmet: >3 days	Yield loss: None	Quality Change: 3% Total: 17,720 lbs/A Fr: 6,877 lbs/A Proc: 10,524 lbs/A No sale: 319 lbs/A	Change to: $2,044/A	Change to: $1,982/A	Change to: $62/A **Net Loss:** $52/A
3 REIs: AZM : >14 days Phosmet: >3 days	Yield loss: 1% Reduces Yield to: Total:17,543 lbs/A Fr: 7,017 lbs/A Proc: 10,526 lbs/A	Quality Change: 3-5% Fr: 6,666-6,807 lbs/A Proc: 10,000-10,210 lbs/A No Sale: 316-524 lbs/A	Change to: $1,991/A to $2,022/A	Change to: SP 1: $2,077/A SP 2: $2,074/A to $2,210/A	Change to: SP 1: -$55 to -$86/A SP 2: -$52 to -$219/A **Net Loss:** SP1: $169/A to $200/A SP2: $166/A to $333/A
4 REIs: AZM : =/<14 days, 1 app. Phosmet: =/<3 days	Yield loss: None	Quality Change: 1% Fr: 7,019 lbs/A Proc: 10,595 lbs/A No Sale: 106 lbs/A	Change to: $2,076/A	Change to: $2,013/A	Change to: $63/A **Net Loss:** $51/A

SP 1 refers to spray program 1 and SP 2 refers to spray program 2.

East Region

Regional Level Impacts

Regional level impacts are an aggregate of grower level impacts taking into consideration the number of acres grown in a region, and the percent of regional acreage treated with azinphos-methyl or phosmet (depending on the Scenario being discussed). Regional impacts are estimated for each of the smaller regions in the East Region (i.e., New England, Appalachian/Southern and North Central Regions), assuming that at the grower level, the impacts faced in each region will be similar.

SCENARIO 1

Azinphos-methyl REI >14 days, and phosmet REI/PHI less than or equal to 3 days. Azinphos-methyl would no longer be used by growers.

1. Net Revenue (Profit) Impacts

East Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 203,900 apple acres grown in the East Region. Assume net revenues of $23.3 million dollars in the East Region from growing apples.

B. Assume revenues decline to $2,044 per acre, and costs increase to $2,045 per acre. The range of net revenues would equal -$1 per acre.

Assume 80% of East Region acreage treated with azinphos-methyl. Assume this is the acreage potentially impacted (163,120 acres). The remaining 40,780 acres will not be impacted.

Assume profits of $4.45 million - a decline of 81% - in the East Region producing apples without azinphos-methyl.

New England Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 77,700 apple acres grown in the New England Region. Assume net revenues of $8.9 million dollars in the New England Region from growing apples.

B. Assume revenues decline to $2,044 per acre, and costs increase to $2,045 per acre. The range of net revenues would equal -$1 per acre.

Assume 75% of New England Region acreage treated with azinphos-methyl. Assume this is the acreage potentially impacted (58,275 acres). The remaining 19,425 acres will not be impacted.

Assume profits of $2.1 million - a decline of 76% - in the New England Region producing apples without azinphos-methyl.

Appalachian/Southern Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 65,100 apple acres grown in the Appalachian/Southern Region. Assume net revenues of $7.4 million dollars in the Appalachian/Southern Region from growing apples.

B. Assume revenues decline to $2,044 per acre, and costs increase to $2,045 per acre. The range of net revenues would equal -$1 per acre.

Assume 78% of Appalachian/Southern Region acreage treated with azinphos-methyl. Assume this is the acreage potentially impacted (50,778 acres). The remaining 14,332 acres will not be impacted.

Assume profits of $1.5 million - a decline of 80% - in the Appalachian/Southern Region producing apples without azinphos-methyl.

North Central Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 61,100 apple acres grown in the North Central Region. Assume net revenues of $7 million dollars in the North Central Region from growing apples.

B. Assume revenues decline to $2,044 per acre, and costs increase to $2,045 per acre. The range of net revenues would equal -$1 per acre.

Assume 87% of North Central Region acreage treated with azinphos-methyl. Assume this is the acreage potentially impacted (53,157 acres). The remaining 7,943 acres will not be impacted.

Assume profits of $0.85 million - a decline of 88% - in the North Central Region producing apples without azinphos-methyl.

SCENARIO 2
Azinphos-methyl REI equal to 14 days, and phosmet REI/PHI >3 days. Phosmet would no longer be used by growers.

1. Net Revenue (Profit) Impacts
East Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 203,900 apple acres grown in the East Region. Assume net revenues of $23.3 million dollars in the East Region from growing apples.

B. Assume revenues decline to $2,044 per acre, and costs increase to $1,982 per acre. The range of net revenues would equal $62 per acre.

Assume 41% of East Region acreage treated with phosmet. Assume this is the acreage potentially impacted (83,600 acres). The remaining 120,300 acres will not be impacted.

Assume profits of $18.7 million - a decline of 20% - in the East Region producing apples without phosmet.

New England Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 77,700 apple acres grown in the New England Region. Assume net revenues of $8.9 million dollars in the New England Region from growing apples.

B. Assume revenues decline to $2,044 per acre, and costs increase to $1,982 per acre. The range of net revenues would equal $62 per acre.

Assume 33% of New England Region acreage treated with phosmet. Assume this is the acreage potentially impacted (22,641 acres). The remaining 52,059 acres will not be impacted.

Assume profits of $7.3 million - a decline of 18% - in the New England Region producing apples without phosmet.

Appalachian/Southern Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 65,100 apple acres grown in the Appalachian/Southern Region. Assume net revenues of $7.4 million dollars in the Appalachian/Southern Region from growing apples.

B. Assume revenues decline to $2,044 per acre, and costs increase to $1,982 per acre. The range of net revenues would equal $62 per acre.

Assume 32% of Appalachian/Southern Region acreage treated with phosmet. Assume this is the acreage potentially impacted (20,832 acres). The remaining 44,268 acres will not be impacted.

Assume profits of $6.3 million - a decline of 15% - in the Appalachian/Southern Region producing apples without phosmet.

North Central Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 61,100 apple acres grown in the North Central Region. Assume net revenues of $7 million dollars in the North Central Region from growing apples.

B. Assume revenues decline to $2,044 per acre, and costs increase to $1,982 per acre. The range of net revenues would equal $62 per acre.

Assume 60% of North Central Region acreage treated with phosmet. Assume this is the acreage potentially impacted (36,660 acres). The remaining 24,440 acres will not be impacted.

Assume profits of $5.1 million - a decline of 27% - in the North Central Region producing apples without phosmet.

SCENARIO 3
Azinphos-methyl REI >14 days, and phosmet REI/PHI >3 days. Azinphos-methyl and phosmet would no longer be used by growers.

1. Net Revenue (Profit) Impacts

East Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 203,900 apple acres grown in the East Region. Assume net revenues of $23.3 million dollars in the East Region from growing apples.

B. Spray Program 1: Assume revenues decline to $1,991 to $2,022 per acre, costs increase to $2,077 per acre. The range of net revenues would equal -$56 to -$86 per acre. (Spray program 1 will likely be adopted in the Appalachian/Southern and North Central Regions due to the availability of all of the compounds in these regions, and its relatively smaller cost to implement compared to Spray Program 2.)

Assume as much as 80% of East Region acreage treated with azinphos-methyl and phosmet. Assume this is the acreage potentially impacted (163,120 acres). The remaining 40,780 acres will not be impacted.

Assume a range of profits of -$4.2 million to -$9.3 million under spray program 1 - a decline 1 to 1 ½ times the current region net revenues - in the East Region producing apples without azinphos-methyl and phosmet.

Spray Program 2: Assume revenues decline to $1,991 to $2,022 per acre, and costs increase to $2,074 to $2,210 per acre. The range of net revenues would equal -$52 to -$219 per acre. (The New England Region - in particular New York - would likely adopt this program due to the unavailability of methoxyfenozide in this region.)

Assume as much as 80% of East Region acreage treated with azinphos-methyl and phosmet. Assume this is the acreage potentially impacted (163,120 acres). The remaining 40,780 acres will not be impacted.

Assume a range of profits of -$4 million to -$31.1 million under spray program 2 - a decline 1 to 2 ½ times the current region net revenues - in the East Region producing apples without azinphos-methyl and phosmet.

New England Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 77,700 apple acres grown in the New England Region. Assume net revenues of $8.9 million dollars in the New England Region from growing apples.

B. Assume revenues decline to $1,991 to $2,022 per acre, and costs increase to $2,074 to $2,210 per acre. The range of net revenues would equal -$52 to -$219 per acre. (Methoxyfenozide is not registered in New York for use on apples, so the assumption is that in this region, growers would choose spray program 2, which is synthetic pyrethroid based. Under this program they would get the above net revenues per acre. Under spray program 1, net revenues would be -$55 to -$86 per acre.)

Assume as much as 75% of New England Region acreage treated with azinphos-methyl and phosmet. Assume this is the acreage potentially impacted (58,275 acres). The remaining 19,425 acres will not be impacted.

Assume a range of profits of -$0.8 million to -$10.6 million under spray program 2 - a decline 1 to 2 1/4 times the current region net revenues - in the New England Region producing apples without azinphos-methyl and phosmet. (Under spray program 1, regional profits would be -$1 million to -$2.8 million.)

Appalachian/Southern Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 65,100 apple acres grown in the Appalachian/Southern Region. Assume net revenues of $7.4 million dollars in the Appalachian/Southern Region from growing apples.

B. Assume revenues decline to $1,991 to $2,022 per acre, and costs increase to $2,077 per acre. The range of net revenues would equal -$55 to -$86 per acre. (Since methoxyfenozide is registered in this region, it is assumed that growers will choose spray program 1, which is cheaper per acre and is not expected to result in secondary pest outbreaks.)

Assume as much as 78% of Appalachian Southern/Region acreage treated with azinphos-methyl and phosmet. Assume this is the acreage potentially impacted (50,778 acres). The remaining 14,332 acres will not be impacted.

Assume a range of profits of -$1.2 million to -$2.8 million - a decline of 1 to 1 ½ times the current regional profit level - in the Appalachian/Southern Region producing apples without azinphos-methyl and phosmet.

North Central Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 61,100 apple acres grown in the North Central Region. Assume net revenues of $7 million dollars in the North Central Region from growing apples.

B. Assume revenues decline to $1,991 to $2,022 per acre, and costs increase to $2,077 per acre. The range of net revenues would equal -$55 to -$86 per acre. (Since methoxyfenozide is registered in this region, it is assumed that growers will choose spray program 1, which is cheaper per acre and is not expected to result in secondary pest outbreaks.)

Assume as much as 87% of North Central Region acreage treated with azinphos-methyl and phosmet. Assume this is the acreage potentially impacted (53,157 acres). The remaining 7,943 acres will not be impacted.

Assume a range of profits of -$2 million to -$3.7 - a decline of 1 1/4 to 1 ½ times the current region profit level - in the North Central Region producing apples without azinphos-methyl and phosmet.

SCENARIO 4

One application of azinphos-methyl at an REI equal to 14 days, and phosmet REI/PHI less than or equal to 3 days.

1. Net Revenue (Profit) Impacts

East Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 203,900 apple acres grown in the East Region. Assume net revenues of $23.3 million dollars in the East Region from growing apples.

B. Assume revenues decline to $2,076 per acre, and costs increase to $2,013 per acre. The range of net revenues would equal $63 per acre.

Assume 80% of East Region acreage treated with phosmet and azinphos-methyl. Assume this is the acreage potentially impacted (163,120 acres). The remaining 40,780 acres will not be impacted.

Assume profits of $14.9 million - a decline of 36% - in the East Region producing apples under Scenario 4.

New England Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 77,700 apple acres grown in the New England Region. Assume net revenues of $8.9 million dollars in the New England Region from growing apples.

B. Assume revenues decline to $2,076 per acre, and costs increase to $2,013 per acre. The range of net revenues would equal $63 per acre.

Assume 75% of New England Region acreage treated with phosmet and azinphos-methyl. Assume this is the acreage potentially impacted (58,275 acres). The remaining 19,425 acres will not be impacted.

Assume profits of $5.9 million - a decline of 34% - in the New England Region producing apples under Scenario 4.

Appalachian/Southern Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 65,100 apple acres grown in the Appalachian/Southern Region. Assume net revenues of $7.4 million dollars in the Appalachian/Southern Region from growing apples.

B. Assume revenues decline to $2,076 per acre, and costs increase to $2,013 per acre. The range of net revenues would equal $63 per acre.

Assume 78% of Appalachian/Southern Region acreage treated with phosmet and azinphos-methyl. Assume this is the acreage potentially impacted (50,778 acres). The remaining 14,332 acres will not be impacted.

Assume a range of profits of $4.8 million - a decline of 35% - in the Appalachian/Southern Region producing apples under Scenario 4.

North Central Region

A. Assume that current revenues are equal to $2,090 per acre, and costs are $1,976 per acre, resulting in net revenues of $114 per acre. Assume 61,100 apple acres grown in the North Central Region. Assume net revenues of $7 million dollars in the North Central Region from growing apples.

B. Assume revenues decline to $2,076 per acre, and costs increase to $2,013 per acre. The range of net revenues would equal $63 per acre.

Assume 87% of North Central Region acreage treated with phosmet and azinphos-methyl. Assume this is the acreage potentially impacted (53,157 acres). The remaining 7,943 acres will not be impacted.

Assume a range of profits of $4.2 million - a decline of 40% - in the North Central Region producing apples under Scenario 4.

East Region Regional Level Impacts Summary

Scenario	Region	Net Revenues
1 REIs: AZM : >14 days Phosmet: =/<3 days	East	Current Total: $23.3 million New Total: $4.45 million Net Loss: $18.85 million
	New England	Current Total: $8.9 million New Total: $2.1 million Net Loss: $6.8 million
	Appalachian/Southern	Current Total: $7.4 million New Total: $1.5 million Net Loss: $5.9 million
	North Central	Current Total: $7 million New Total: $0.85 million Net Loss: $6.15 million
2 REIs: AZM : =/<14 days Phosmet: >3 days	East	Current Total: $23.3 million New Total: $18.7 million Net Loss: $4.6 million
	New England	Current Total: $8.9 million New Total: $7.3 million Net Loss: $1.6 million
	Appalachian/Southern	Current Total: $7.4 million New Total: $6.3 million Net Loss: $1.1 million
	North Central	Current Total: $7 million New Total: $5.1 million Net Loss: $1.9 million

Scenario	Region	Net Revenues
3 REIs: AZM: >14 days Phosmet: >3 days	East	Current Total: $23.3 million SP1: New Total: -$4.2 million to -$9.3 million Net Loss: $27.5 million to $32.6 million SP2: New Total: -$4 million to -$31.1 million Net Loss: $27.3 million to $54.4 million
	New England	Current Total: $8.9 million New Total: -$0.8 million to -$10.6 million Net Loss: $9.7 million to $19.5 million
	Appalachian/Southern	Current Total: $7.4 million New Total: -$1.2 million to -$2.8 million Net Loss: $8.6 million to $10.2 million
	North Central	Current Total: $7 million New Total: -$2 million to -$3.7 Net Loss: $9 million to $10.7 million
4 REIs: AZM : =/<14 days, 1 application Phosmet: =/<3 days	East	Current Total: $23.3 million New Total: $14.9 million Net Loss: $8.4 million
	New England	Current Total: $8.9 million New Total: $5.9 million Net Loss: $3 million
	Appalachian/Southern	Current Total: $7.4 million New Total: $4.8 million Net Loss: $2.6 million
	North Central	Current Total: $7 million New Total: $4.2 million Net Loss: $2.8 million

SP 1 refers to spray program 1 and SP 2 refers to spray program 2.

West Region

Grower Level Impacts
Assume if a grower uses azinphos-methyl and phosmet, the grower uses azinphos-methyl and phosmet on every acre grown.

SCENARIO 1

Azinphos-methyl REI >14 days, and phosmet REI/PHI less than or equal to 3 days. Azinphos-methyl would no longer be used by growers.

1. Revenue Impact:
Revenues are impacted through changes in yield and in quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold. The potential changes to yield and quality are as follows:

A. Assume in the West produce 30,092 pounds of apples per acre, with a value of $4,275 per acre. This assumes 20,462 pounds per acre (68%) is destined for the fresh market (at a price of $0.19 per pound), and 9,630 pounds per acre (32%) is destined for the processed market (at a price of $0.04 per pound). This also assumes that fresh export and fresh domestic apples receive the same price per pound.

B. Assume a yield loss of 1% due to lack of effective alternative control of target pests. On a per acre level, a 1% in yield equates to a reduction in production of 301 pounds per acre, reducing yield to 29,789 pounds per acre. Production destined for the fresh market would equal 20,257 pounds per acre (68% of total production), production destined for the processed market would equal 9,532 pounds per acre (32% of total production).

C. Assume a reduction in the quality (size and color) of the apple produced as a result of damaged caused by an increase in insect presence on the fruit with alternative chemical control. This could potentially lead to a change in the end use market for the apples (i.e., fresh export, fresh domestic, processed, or no sale) and, therefore, the price received for production.

Assume the price received by growers for fresh market apples is equal to $0.19 per pound, and for processed market apples, $0.04 per pound. Also assume the potential change in price received for production equal to $0 per pound (no change in end use market to $0.15 per ton (change from fresh market to processed market)).

Assume a 3% to 5% reduction in the quality (end use market) of the apples produced. Assume 3% to 5% of the current fresh apple production per acre goes to the processed market, and 3% to 5% of the current processed apple production per acre is not sold. Production destined for the fresh market declines to 19,244 to 19,649 pounds per acre, and production destined for the processed market increases to 9,854 to 10,068 pounds per acre. The remaining 286 to 477 pounds per acre produced is not sold.

D. Assume the value of the fresh market production declines to $3,656 to $3,733 per acre, and the value of processed market production increases to $394 to $403 per acre. Revenues would equal $4,059 (5% yield loss) to $4,127 (3% yield loss) per acre - a decline of 3% to 5% from current per acre revenues of $4,275 per acre.

2. Cost Impact

A. Assume costs could be as much as $4,004 per acre ($2,026 variable costs, and $1,978 fixed costs).

B. Assume fixed costs are unchanged.

C. Assume a change in variable costs due to additional insecticide control to replace the average of 3 applications of azinphos-methyl.

1. Assume 3 additional applications of phosmet for the control of target pests. Additional cost of $19 per acre.

2. Assume 2 additional applications of methoxyfenozide for target pest control. Additional cost (assuming the cost of methoxyfenozide is the same as tebufenozide) of $38 per acre.

D. Assume a change in the number of acres using mating disruption. Currently an estimated 50% of acreage is managed using mating disruption. Assume an additional 25% of the acres would adopt a full program at a cost of $120 per acre. The 50% already in the program would move to a full program at an additional $60 per acre. The remaining 25% of the acreage would not take part in mating disruption. The range of cost is $0 to $120 per acre.

D. Assume variable costs increase $57 to $177 per acre.

E. Assume total costs increase from $4,004 to $4,061to $4,481 per acre - an increase of 3% to 4%.

3. Net Revenue (Profit) Impacts

Per Acre
A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004 per acre, resulting in net revenues of $271 per acre.

B. Assume revenues decline to $4,059 to $4,127 per acre, and costs are $4,061 to $4,181 per acre. The range of net revenues would equal -$122 to $66 per acre - a decline of 3/4 to 1 ½ times the current per acre profit level.

Per Farm
C. Assume that total current farm profits equal $7,046 (an average of 26 acres per farm at profits of $271per acre) in the West Region from apple production.

D. Assume per farm profits decline to -$3,172 to $1,716 - a decline of 3/4 to 1 ½ times the current per farm profit level with the loss of azinphos-methyl for apple production in the West Region.

SCENARIO 2

Azinphos-methyl REI equal to 14 days, and phosmet REI/PHI >3 days. Phosmet would no longer be used by growers.

1. Revenue Impact:
Revenues are impacted through changes in yield and in quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold. The potential changes to yield and quality are as follows:

A. Assume in the West produce 30,092 pounds of apples per acre, with a value of $4,275 per acre. This assumes 20,462 pounds per acre (68%) is destined for the fresh market (at a price of $0.19 per pound), and 9,630 pounds per acer (32%) is destined for the processed market (at a price of $0.04 per pound). This also assumes that fresh export and fresh domestic apples receive the same price per pound.

B. Assume no loss in yield with phosmet unavailable for use in the West Region.

C. Assume a reduction in the quality (size and color) of the apple produced as a result of damaged caused by an increase in insect presence on the fruit with alternative chemical control. This could potentially lead to a change in the end use market for the apples (i.e., fresh export, fresh domestic, processed, or no sale) and, therefore, the price received for production.

Assume the price received by growers for fresh market apples is equal to $0.19 per pound, and for processed market apples, $0.04 per pound. Also assume the potential change in price received for production equal to $0 per pound (no change in end use market to $0.15 per ton (change from fresh market to processed market)).

Assume a 2% reduction in the quality (end use market) of the apples produced. Assume 2% of the current fresh apple production per acre goes to the processed market, and 2% of the current processed apple production per acre is not sold. Production destined for the fresh market declines to 20,053 pounds per acre, and production destined for the processed market increases to 9,846 pounds per acre. The remaining 193 pounds per acre produced is not sold.

D. Assume the value of the fresh market production declines to $3,810 per acre, and the value of processed market production increases to $394 per acre. Revenues would equal $4,204 - a decline of 2% from current per acre revenues of $4,275 per acre.

2. Cost Impact

A. Assume costs could be as much as $4,004 per acre ($2,026 variable costs, and $1,978 fixed costs).

B. Assume fixed costs are unchanged.

C. Assume a change in variable costs due to additional insecticide control to replace the average of 2 applications of phosmet.

1. Assume 2 additional applications azinphos-methyl for the control of target pests. A savings of $4 per acre due to the decreased on cost of azinphos-methyl compared to phosmet.

2. Assume 1additional application of methoxyfenozide for target pest control. Additional cost of $19 per acre.

D. Assume a change in the number of acres using mating disruption. Currently an estimated 50% of acreage is managed using mating disruption. Assume an additional 25% of the acres would adopt a full program at a cost of $120 per acre. The 50% already in the program would move to a full program at an additional $60 per acre. The remaining 25% of the acreage would not take part in mating disruption. The range of cost is $0 to $120 per acre.

D. Assume variable costs increase $15 to $135 per acre.

E. Assume total costs increase from $4,004 to $4,019 to $4,139 per acre - an increase of <1% to 3%.

3. Net Revenue (Profit) Impacts

Per Acre

A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004 per acre, resulting in net revenues of $271 per acre.

B. Assume revenues decline to $4,204 per acre, and costs are $4,019 to $4,139 per acre. The range of net revenues would equal $65 to $185 per acre - a decline of 32% to 76% from the current per acre profit level.

Per Farm

C. Assume that total current farm profits equal $7,046 (an average of 26 acres per farm at profits of $271per acre) in the West Region from apple production.

D. Assume per farm profits decline to $1,690 to $4,810 - a decline of 32% to 76% from the current per farm profit level with the loss of phosmet for apple production in the West Region.

SCENARIO 3

Azinphos-methyl REI >14 days, and phosmet REI/PHI >3 days. Azinphos-methyl and phosmet would no longer be used by growers.

1. Revenue Impact:

Revenues are impacted through changes in yield and in quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold. The potential changes to yield and quality are as follows:

A. Assume in the West produce 30,092 pounds of apples per acre, with a value of $4,275 per acre. This assumes 20,462 pounds per acre (68%) is destined for the fresh market (at a price of $0.19 per pound), and 9,630 pounds per acer (32%) is destined for the processed market (at a price of $0.04 per pound). This also assumes that fresh export and fresh domestic apples receive the same price per pound.

B. Assume a yield loss of 1% due to lack of effective alternative control of target pests. On a per acre level, a 1% in yield equates to a reduction in production of 301 pounds per acre, reducing yield to 29,789 pounds per acre. Production destined for the fresh market would equal 20,257 pounds per acre (68% of total production), production destined for the processed market would equal 9,532 pounds per acre (32% of total production).

C. Assume a reduction in the quality (size and color) of the apple produced as a result of damaged caused by an increase in insect presence on the fruit with alternative chemical control. This could potentially lead to a change in the end use market for the apples (i.e., fresh export, fresh domestic, processed, or no sale) and, therefore, the price received for production.

Assume the price received by growers for fresh market apples is equal to $0.19 per pound, and for processed market apples, $0.04 per pound. Also assume the potential change in price received for production equal to $0 per pound (no change in end use market to $0.15 per ton (change from fresh market to processed market)).

Assume a 5% to 7% reduction in the quality (end use market) of the apples produced. Assume 5% to 7% of the current fresh apple production per acre goes to the processed market, and 5% to 7% of the current processed apple production per acre is not sold. Production destined for the fresh market declines to 18,839 to 19,244 pounds per acre, and production destined for the processed market increases to 10,068 to 10,283 pounds per acre. The remaining 477 to 667 pounds per acre produced is not sold.

D. Assume the value of the fresh market production declines to $3,579 to $3,656 per acre, and the value of processed market production increases to $403 to $411 per acre. Revenues would equal $3,990 (7% yield loss) to $4,059 (5% yield loss) per acre - a decline of 5% to 7% from current per acre revenues of $4,275 per acre.

2. Cost Impact

A. Assume costs could be as much as $4,004 per acre ($2,026 variable costs, and $1,978 fixed costs).

B. Assume fixed costs are unchanged.

C. Assume a change in variable costs due to additional insecticide control to replace the average of 3 applications of azinphos-methyl and 2 applications of phosmet. There is a potential for two different spray programs to be adopted, depending on the availability of compounds in a particular state or region. For example, methoxyfenozide is not registered in California, so they would not likely choose spray program 1.

1. Spray Program 1

A. Assume an additional 3 applications of methoxyfenozide, 1 application of tebufenozide, and 1 application of spinosad for the control of target pests. Cost (assuming the cost of methoxyfenozide and thiamethoxam the same as tebufenozide) of $110 per acre.

B. Assume a change in the number of acres using mating disruption. Currently an estimated 50% of acreage is managed using mating disruption. Assume an additional 25% of the acres would adopt a full program at a cost of $120 per acre. The

50% already in the program would move to a full program at an additional $60 per acre. The remaining 25% of the acreage would not take part in mating disruption. The range of cost is $0 to $120 per acre.

C. Assume an increase in variable costs of $41 to $161 per acre (current cost of azinphos-methyl and phosmet applications totals $69 per acre).

2. Spray program 2

A. Assume an additional 3 applications of esfenvalerate, 1 application of tebufenozide, and 1 application of spinosad for the control of target pests. Cost of $70 per acre.

B. Assume additional applications of chemicals for the control of secondary pest outbreaks from the use of synthetic pyrethroids.

1. Assume 1-3 additional application of miticides (abamectin or pyridaben) at a cost of $52 to $156 per acre.

2. Assume 1-2 additional applications of imidacloprid for aphid and leafminer at a cost of $18 to $36 per acre.

3. Assume 1 additional application of *Bt* for control of leafroller at cost of $15 per acre.

C. Assume a cost of primary and secondary pest control of $155 to $277 per acre.

D. Assume a change in the number of acres using mating disruption. Currently an estimated 50% of acreage is managed using mating disruption. Assume an additional 25% of the acres would adopt a full program at a cost of $120 per acre. The 50% already in the program would move to a full program at an additional $60 per acre. The remaining 25% of the acreage would not take part in mating disruption. The range of cost is $0 to $120 per acre.

E. Assume an increase in variable costs of $86 to $328 per acre (current cost of azinphos-methyl and phosmet applications totals $69 per acre).

D. Assume, under spray program 1, total costs increase from $4,004 per acre to $4,045 to $4,165 per acre - an increase of 1% to 4%; and under spray program 2, total costs increase from $4,004 to $4,090 to $4,332 per acre - an increase of 2% to 8%.

3. Net Revenue (Profit) Impacts

Per Acre
A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004 per acre, resulting in net revenues of $271 per acre.

B. Assume revenues decline to $3,990 to $4,059 per acre, and, under spray program 1, costs are $4,045 to $4,165 per acre. The range of net revenues would equal -$175 to $14 per acre - a decline of 1 to 1 3/4 times the current per acre profit level.

Assume revenues decline to $3,990 to $4,059 per acre, and, under spray program 2, costs are $4,090 to $4,332 per acre. The range of net revenues would equal -$342 to -$31 per acre - a decline of 1 to 2 ½ times the current per acre profit level.

Per Farm
C. Assume that total current farm profits equal $7,046 (an average of 26 acres per farm at profits of $271per acre) in the West Region from apple production.

D. Assume, under spray program 1, per farm profits of -$4,550 to $364 - a decline of 1 to 1 3/4 times the current per farm profit level; and, under spray program 2, per farm profits of -$806 to -$8,892 - a decline of 1 to 2 ½ times the current per farm profit level with the loss of azinphos-methyl and phosmet for apple production in the West Region.

SCENARIO 4

One application of azinphos-methyl at an REI equal to 14 days, and phosmet REI/PHI less than or equal to 3 days.

1. Revenue Impact:
Revenues are impacted through changes in yield and in quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold. The potential changes to yield and quality are as follows:

A. Assume in the West produce 30,092 pounds of apples per acre, with a value of $4,275 per acre. This assumes 20,462 pounds per acre (68%) is destined for the fresh market (at a price of $0.19 per pound), and 9,630 pounds per acer (32%) is destined for the processed market (at a price of $0.04 per pound). This also assumes that fresh export and fresh domestic apples receive the same price per pound.

B. Assume no loss in yield.

C. Assume a reduction in the quality (size and color) of the apple produced as a result of damaged caused by an increase in insect presence on the fruit with alternative chemical control. This could potentially lead to a change in the end use market for the apples (i.e., fresh export, fresh domestic, processed, or no sale) and, therefore, the price received for production.

Assume the price received by growers for fresh market apples is equal to $0.19 per pound, and for processed market apples, $0.04 per pound. Also assume the potential change in price received for production equal to $0 per pound (no change in end use market to $0.15 per ton (change from fresh market to processed market)).

Assume a 1% reduction in the quality (end use market) of the apples produced. Assume 1% of the current fresh apple production per acre goes to the processed market, and 1% of the current processed apple production per acre is not sold. Production destined for the fresh market declines to 20,257 pounds per acre, and production destined for the processed market increases to 9,739 pounds per acre. The remaining 96 pounds per acre produced is not sold.

D. Assume the value of the fresh market production declines to $3,849 per acre, and the value of processed market production increases to $390 per acre. Revenues would equal $4,239 per acre - a decline of 1% from current per acre revenues of $4,275 per acre.

2. Cost Impact

A. Assume costs could be as much as $4,004 per acre ($2,026 variable costs, and $1,978 fixed costs).

B. Assume fixed costs are unchanged.

C. Assume a change in variable costs due to additional insecticide control to replace the average of 2 applications of azinphos-methyl.

1. Assume 2 additional applications of phosmet for the control of target pests. Additional cost of $4 per acre.

D. Assume a change in the number of acres using mating disruption. Currently an estimated 50% of acreage is managed using mating disruption. Assume an additional 25% of the acres would adopt a half program at a cost of $60 per acre. The 50% already in the program would remain at half programs. The remaining 25% of the acreage would not take part in mating disruption. The range of cost is $0 to $60 per acre.

E. Assume variable costs increase $4 to $64 per acre.

F. Assume total costs increase from $4,004 per acre to $4,008 to $4,068 per acre - an increase of <1% to 2%.

3. Net Revenue (Profit) Impacts

Per Acre

A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004per acre, resulting in net revenues of $271 per acre.

B. Assume revenues decline to $4,239 per acre, and costs are $4,008 to $4,068 per acre. The range of net revenues would equal $171 to $231 per acre - a decline of 15% to 37% of the current per acre profit level.

Per Farm

C. Assume that total current farm profits equal $7,046 (an average of 26 acres per farm at profits of $271per acre) in the West Region from apple production.

D. Assume per farm profits decline to $4,446 to $6,006 - a decline of 15% to 37% of the current per farm profit level.

West Region Grower Level Impacts Summary

Scenario	Yield	Quality Impact (Price)	Revenues	Costs	Net Revenues
Current Situation	Current total: 30,092 lbs/A Fr: 20,462 lbs/A Proc: 9,630 lbs/A	Prices: Fr: $0.19/ton Proc: $0.04/ton	Current: $4,275/A	Current: $4,004/A	Current: $271/A
1 REIs: AZM : >14 days Phosmet: =/<3 days	Yield loss: 1% Reduces Yield to: Total: 29,257 lbs/A Fr: 20,257 lbs/A Proc: 9,532 lbs/A	Quality Change: 3-5% Fr: 19,244-19,649 lbs/A Proc: 9,854-10,068 lbs/A No Sale: 286-477 lbs/A	Change to: $4,059/A to $4,127/A	Change to: $4,061/A to $4181/A	Change to: -$122/A to $66/A **Net Loss:** $205/A to $393/A
2 REIs: AZM : =/<14 days Phosmet: >3 days	Yield loss: None	Quality Change: 2% Fr: 20,053 lbs/A Proc: 9,846 lbs/A No Sale: 193 lbs/A	Change to: $4,204/A	Change to: $4,019/A to $4,139/A	Change to: $65/A to $185/A **Net Loss:** $86/A to $206/A
3 REIs: AZM : >14 days Phosmet: >3 days	Yield loss: 1% Reduces Yield to: Total: 29,257 lbs/A Fr: 20,257 lbs/A Proc: 9,532 lbs/A	Quality Change: 5-7% Fr: 18,839-19,244 lbs/A Proc: 10,068-10,283 lbs/A No Sale: 477-667 lbs/A	Change to: $3,990/A to $4,059/A	Change to: SP 1: $4,045/A to $4,165/A SP 2: $4,090/A to $4,332/A	Change to: SP 1: -$175 to $14/A SP 2: -$31 to - $342/A **Net Loss:** SP 1: $257/A to $446/A SP 2: $302/A to $613/A
4 REIs: AZM : =/<14 days, 1 app. Phosmet: =/<3 days	Yield loss: None	Quality Change: 1% Fr: 20,257 lbs/A Proc: 9,739 lbs/A No Sale: 96 lbs/A	Change to: $4,239/A	Change to: $4,008/A to $4,068/A	Change to: $171/A to $231/A **Net Loss:** $40/A to $100/A

SP 1 refers to spray program 1 and SP 2 refers to spray program 2.

West Region

Regional Level Impacts
Regional level impacts are an aggregate of grower level impacts taking into consideration the number of acres grown in a region and the percent of regional acreage treated by azinphos-methyl or phosmet (depending on the Scenario being discussed). Regional impacts are estimated for each of the smaller regions in the West Region (i.e., Pacific North and Pacific South Regions), assuming that at the grower level, the impacts faced in each region will be similar.

SCENARIO 1

Azinphos-methyl REI >14 days, and phosmet REI/PHI less than or equal to 3 days. Azinphos-methyl would no longer be used by growers.

1. Net Revenue (Profit) Impacts

West Region

A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004 per acre, resulting in net revenues of $271 per acre. Assume 220,600 apple acres grown in the West Region. Assume net revenues of $59.8 million dollars in the West Region from growing apples.

B. Assume revenues decline to $4,059 to $4,127 per acre, and costs increase to $4,061 to $4,481 per acre. The range of net revenues would equal -$122 to $66 per acre.

Assume 76% of West Region acreage treated with azinphos-methyl. Assume this is the acreage potentially impacted (167,656 acres). The remaining 52,944 acres will not be impacted.

Assume a range of profits of -$6 million to $25.3 million - a decline of ½ to 1 times the current region profit level - in the West Region producing apples without azinphos-methyl.

Pacific North Region

A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004 per acre, resulting in net revenues of $271 per acre. Assume 180,700 apple acres grown in the Pacific North Region. Assume net revenues of $49 million dollars in the Pacific North Region from growing apples.

B. Assume revenues decline to $4,059 to $4,127 per acre, and costs increase to $4,061 to $4,481 per acre. The range of net revenues would equal -$122 to $66 per acre.

Assume 84% of Pacific North Region acreage treated with azinphos-methyl. Assume this is the acreage potentially impacted (151,788 acres). The remaining 28,912 acres will not be impacted.

Assume a range of profits of -$10.7 million to $17.8 million - a decline of 3/4 to 1 1/4 times the current region profit level - in the Pacific North Region producing apples without azinphos-methyl.

Pacific South Region

A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004 per acre, resulting in net revenues of $271 per acre. Assume 39,900 apple acres grown in the Pacific South Region. Assume net revenues of $10.8 million dollars in the Pacific South Region from growing apples.

B. Assume revenues decline to $4,059 to $4,127 per acre, and costs increase to $4,061 to $4,481 per acre. The range of net revenues would equal -$122 to $66 per acre.

Assume 39% of Pacific South Region acreage treated with azinphos-methyl. Assume this is the acreage potentially impacted (15,561 acres). The remaining 24,339 acres will not be impacted.

Assume a range of profits of $4.7 million to $7.6 million - a decline of 30% to 56% from the current region profit level - in the Pacific South Region producing apples without azinphos-methyl.

SCENARIO 2

Azinphos-methyl REI equal to 14 days, and phosmet REI/PHI >3 days. Phosmet would no longer be used by growers.

1. Net Revenue (Profit) Impacts

West Region

A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004 per acre, resulting in net revenues of $271 per acre. Assume 220,600 apple acres grown in the West Region. Assume net revenues of $59.8 million dollars in the West Region from growing apples.

B. Assume revenues decline to $4,204 per acre, and costs increase to $4,019 to $4,139 per acre. The range of net revenues would equal $65 to $185 per acre.

Assume 10% of West Region acreage treated with phosmet. Assume this is the acreage potentially impacted (22,060 acres). The remaining 198,540 acres will not be impacted.

Assume a range of profits of $54.9 million to $57.7 million - a decline of 4% to 8% from the current region profit level - in the West Region producing apples without phosmet.

Pacific North Region

A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004 per acre, resulting in net revenues of $271 per acre. Assume 180,700 apple acres grown in the Pacific North Region. Assume net revenues of $49 million dollars in the Pacific North Region from growing apples.

B. Assume revenues decline to $4,204 per acre, and costs increase to $4,019 to $4,139 per acre. The range of net revenues would equal $65 to $185 per acre.

Assume 5% of Pacific North Region acreage treated with phosmet. Assume this is the acreage potentially impacted (9,035 acres). The remaining 171,665 acres will not be impacted.

Assume a range of profits of $47.1 million to $48.2 million - a decline of 2% to 4% from the current region profit level - in the Pacific North Region producing apples without phosmet.

Pacific South Region

A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004 per acre, resulting in net revenues of $271 per acre. Assume 39,900 apple acres grown in the Pacific South Region. Assume net revenues of $10.8 million dollars in the Pacific South Region from growing apples.

B. Assume revenues decline to $4,204 per acre, and costs increase to $4,019 to $4,139 per acre. The range of net revenues would equal $65 to $185 per acre.

Assume 36% of Pacific South Region acreage treated with phosmet. Assume this is the acreage potentially impacted (14,364 acres). The remaining 25,536 acres will not be impacted.

Assume a range of profits of $7.8 million to $9.5 million - a decline of 12% to 28% from the current region profit level - in the Pacific South Region producing apples without phosmet.

SCENARIO 3

Azinphos-methyl REI >14 days, and phosmet REI/PHI >3 days. Azinphos-methyl and phosmet would no longer be used by growers.

1. Net Revenue (Profit) Impacts

West Region

A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004 per acre, resulting in net revenues of $271 per acre. Assume 220,600 apple acres grown in the West Region. Assume net revenues of $59.8 million dollars in the West Region from growing apples.

B. Spray Program 1: Assume revenues decline to $3,990 to $4,059 per acre, and costs increase to $4,045 to $4,165 per acre. The range of net revenues would equal -$175 to $14 per acre. (Spray program 1 will likely be adopted in the Pacific North Region due to the availability of all of the compounds in these regions, and its relatively smaller cost to implement compared to Spray Program 2.)

Assume as much as 76% of West Region acreage treated with azinphos-methyl and phosmet. Assume this is the acreage potentially impacted (167,656 acres). The remaining 52,944 acres will not be impacted.

Assume a range of profits of -$15 million to $16.6 million under spray program 1 - a decline 3/4 to 1 1/4 times the current region net revenues - in the West Region producing apples without azinphos-methyl and phosmet.

Spray Program 2: Assume revenues decline to $3,990 to $4,059 per acre, and costs increase to $4,090 to $4,332 per acre. The range of net revenues would equal -$31 to -$342 per acre. (The Pacific South Region - in particular California - would likely adopt this program due to the unavailability of methoxyfenozide in this region.)

Assume as much as 76% of West Region acreage treated with azinphos-methyl and phosmet. Assume this is the acreage potentially impacted (167,656 acres). The remaining 52,944 acres will not be impacted.

Assume a range of profits of -$43 million to $9.1 million under spray program 2 - a decline 3/4 to 1 3/4 times the current region net revenues - in the West Region producing apples without azinphos-methyl and phosmet.

Pacific North Region

A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004 per acre, resulting in net revenues of $271 per acre. Assume 180,700 apple acres grown in the Pacific North Region. Assume net revenues of $49 million dollars in the Pacific North Region from growing apples.

B. Assume revenues decline to $3,990 to $4,059 per acre, and costs increase to $4,045 to $4,165 per acre. The range of net revenues would equal -$175 to $14 per acre. (Since methoxyfenozide is registered in this region, it is assumed that growers will choose spray program 1, which is cheaper per acre and is not expected to result in secondary pest outbreaks.)

Assume 84% of Pacific North Region acreage treated with azinphos-methyl and phosmet. Assume this is the acreage potentially impacted (151,788 acres). The remaining 28,912 acres will not be impacted.

Assume a range of profits of -$18.8 million to $9.9 million - a decline of more than 3/4 to 1 ½ times the current regional profit level - in the Pacific North Region producing apples without azinphos-methyl and phosmet.

Pacific South Region

A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004 per acre, resulting in net revenues of $271 per acre. Assume 39,900 apple acres grown in the Pacific South Region. Assume net revenues of $10.8 million dollars in the Pacific South Region from growing apples.

B. Assume revenues decline to $3,990 to $4,059 per acre, and costs increase to $4,0909 to $4,332 per acre. The range of net revenues would equal -$31 to -$342 per acre. (Since methoxyfenozide is not registered in this region, it is assumed that growers will choose spray program 2, which substitutes synthetic pyrethroids for methoxyfenozide.)

Assume 39% of Pacific South Region acreage treated with azinphos-methyl and phosmet. Assume this is the acreage potentially impacted (15,561 acres). The remaining 24,339 acres will not be impacted.

Assume a range of profits of $1.3 million to $6.1 million - a decline of 43% to 88% from the current region profit level - in the Pacific South Region producing apples without azinphos-methyl and phosmet.

SCENARIO 4

One application of azinphos-methyl at an REI equal to 14 days, and phosmet REI/PHI less than or equal to 3 days.

1. Net Revenue (Profit) Impacts

West Region

A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004 per acre, resulting in net revenues of $271 per acre. Assume 220,600 apple acres grown in the West Region. Assume net revenues of $59.8 million dollars in the West Region from growing apples.

B. Assume revenues decline to $4,239 per acre, and costs increase to $4,008 to $4,068 per acre. The range of net revenues would equal $171 to $231 per acre.

Assume as much as 76% of West Region acreage treated with azinphos-methyl and phosmet. Assume this is the acreage potentially impacted (167,656 acres). The remaining 52,944 acres will not be impacted.

Assume a range of profits of $43.1 million to $53.1 million - a decline of 11% to 28% from the current region profit level - in the West Region producing apples under Scenario 4.

Pacific North Region

A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004 per acre, resulting in net revenues of $271 per acre. Assume 180,700 apple acres grown in the Pacific North Region. Assume net revenues of $49 million dollars in the Pacific North Region from growing apples.

B. Assume revenues decline to $4,239 per acre, and costs increase to $4,008 to $4,068 per acre. The range of net revenues would equal $171 to $231 per acre.

Assume 84% of Pacific North Region acreage treated with azinphos-methyl and phosmet. Assume this is the acreage potentially impacted (151,788 acres). The remaining 28,912 acres will not be impacted.

Assume a range of profits of $33.8 million to $42.9 million - a decline of 12% to 31% from the current region profit level - in the Pacific North Region producing apples under Scenario 4.

Pacific South Region

A. Assume that current revenues are equal to $4,275 per acre, and costs are $4,004 per acre, resulting in net revenues of $271 per acre. Assume 39,900 apple acres grown in the Pacific South Region. Assume net revenues of $10.8 million dollars in the Pacific South Region from growing apples.

B. Assume revenues decline to $4,239 per acre, and costs increase to $4,008 to $4,068 per acre. The range of net revenues would equal $171 to $231 per acre.

Assume 39% of Pacific South Region acreage treated with azinphos-methyl and phosmet. Assume this is the acreage potentially impacted (15,561 acres). The remaining 24,339 acres will not be impacted.

Assume a range of profits of $9.3 million to $10.2 million - a decline of 42% to 47% from the current region profit level - in the Pacific South Region producing apples under Scenario 4.

West Region Regional Level Impacts Summary

Scenario	Region	Net Revenues
1 REIs: AZM: > 14 days Phosmet: =/<3 days	West	Current Total: $59.8 million New Total: -$6 million to $25.4 million Net Loss: $34.4 million to $65.8 million
	Pacific North	Current Total: $49 million New Total: -$10.7 million to $17.8 million Net Loss: $31.2 million to $59.7 million
	Pacific South	Current Total: $10.8 million New Total: $4.7 million to $7.6 million Net Loss: $3.2 million to $6.1 million
2 REIs: AZM: =/<14 days Phosmet: >3 days	West	Current Total: $59.8 million New Total: $54.9 million to $57.7 million Net Loss: $2.1 million to $4.9 million
	Pacific North	Current Total: $49 million New Total: $47.1 million to $48.2 million Net Loss: $0.8 million to $1.9 million
	Pacific South	Current Total: $10.8 million New Total: $7.8 million to $9.5 million Net Loss: $1.3 million to $3 million
3 REIs: AZM: > 14 days Phosmet: > 3 days	West	Current Total: $59.8 million SP1: New Total: -$15 million to $16.6 million Net Loss: $43.2 million to $74.8 million SP2: New Total: -$43 million to $9.1 million Net Loss: $50.7 million to $102.8 million
	Pacific North	Current Total: $49 million New Total: -$18.8million to $9.9 million Net Loss: $39.1 million to $67.8 million
	Pacific South	Current Total: $10.8 million New Total: $1.3 million to $6.1 million Net Loss: $4.2 million to $9.5 million
4 REIs: AZM: =/< 14 days, 1 application Phosmet: =/<3 days	West	Current Total:$59.8 million New Total: $43.1 million to $53.1 million Net Loss: $6.7 million to $16.7 million
	Pacific North	Current Total: $49 million New Total: $33.8 million to $42.9 million Net Loss: $6.1 million to $15.2 million
	Pacific South	Current Total: $10.8 million New Total: $9.3 million to $10.2 million Net Loss: $0.6 million to $1.5 million

East and West Regions

National Level Impacts

The following table summarizes the impacts of each scenario on the national level. The estimated impacts are simply a sum of the regional level impacts estimated for the East and West Regions for each scenario.

National Level Impacts Summary

Scenario	Region	Net Revenues
1 REIs: AZM: >14 days Phosmet: =/<3 days	US	Current Total: $83.1 million New Total: -$1.55 million to $33.85 million Net Loss: $49.25 million to $84.65 million
	East	Current Total: $23.3 million New Total: $4.45 million Net Loss: $18.85 million
	West	Current Total: $59.8 million New Total: -$6 million to $29.4 million Net Loss: $34.4 million to $65.8 million
2 REIs: AZM: =/<14 days Phosmet: >3 days	US	Current Total: $83.1 million New Total: $73.6 million to $76.4 million Net Loss: $6.7 million to $9.5 million
	East	Current Total: $23.3 million New Total: $18.7 million Net Loss: $4.6 million
	West	Current Total: $59.8 million New Total: $54.9 million to $57.7 million Net Loss: $2.1 million to $4.9 million
3 REIs: AZM: >14 days Phosmet: >3 days	US	Current Total: $83.1 million SP1: New Total: -$24.3 million to $7.3 million Net Loss: $70.7 million to $107.4 million SP2: New Total: -$74.1 million to $5.1 million Net Loss: $78 million to $157.2 million
	East	Current Total: $23.3 million SP1: New Total: -$4.2 million to -$9.3 million Net Loss: $27.5 million to $32.6 million SP2: New Total: -$4 million to -$31.1 million Net Loss: $27.3 million to $54.4 million
	West	Current Total: $59.8 million SP1: New Total: -$15 million to $16.6 million Net Loss: $43.2 million to $74.8 million SP2: New Total: -$43 million to $9.1 million Net Loss: $50.7 million to $102.8 million

Scenario	Region	Net Revenues
4 REIs: AZM: =/<14 days, 1 app. Phosmet: =/<3 days	US	Current Total: $83.1 million New Total: $58 million to $68 million Net Loss: $15.1 million to $25.1 million
	East	Current Total: $23.3 million New Total: $14.9 million Net Loss: $8.4 million
	West	Current Total: $59.8 million New Total: $43.1 million to $53.1 million Net Loss: $6.7 million to $16.7 million

SP 1 refers to spray program 1 and SP 2 refers to spray program 2.

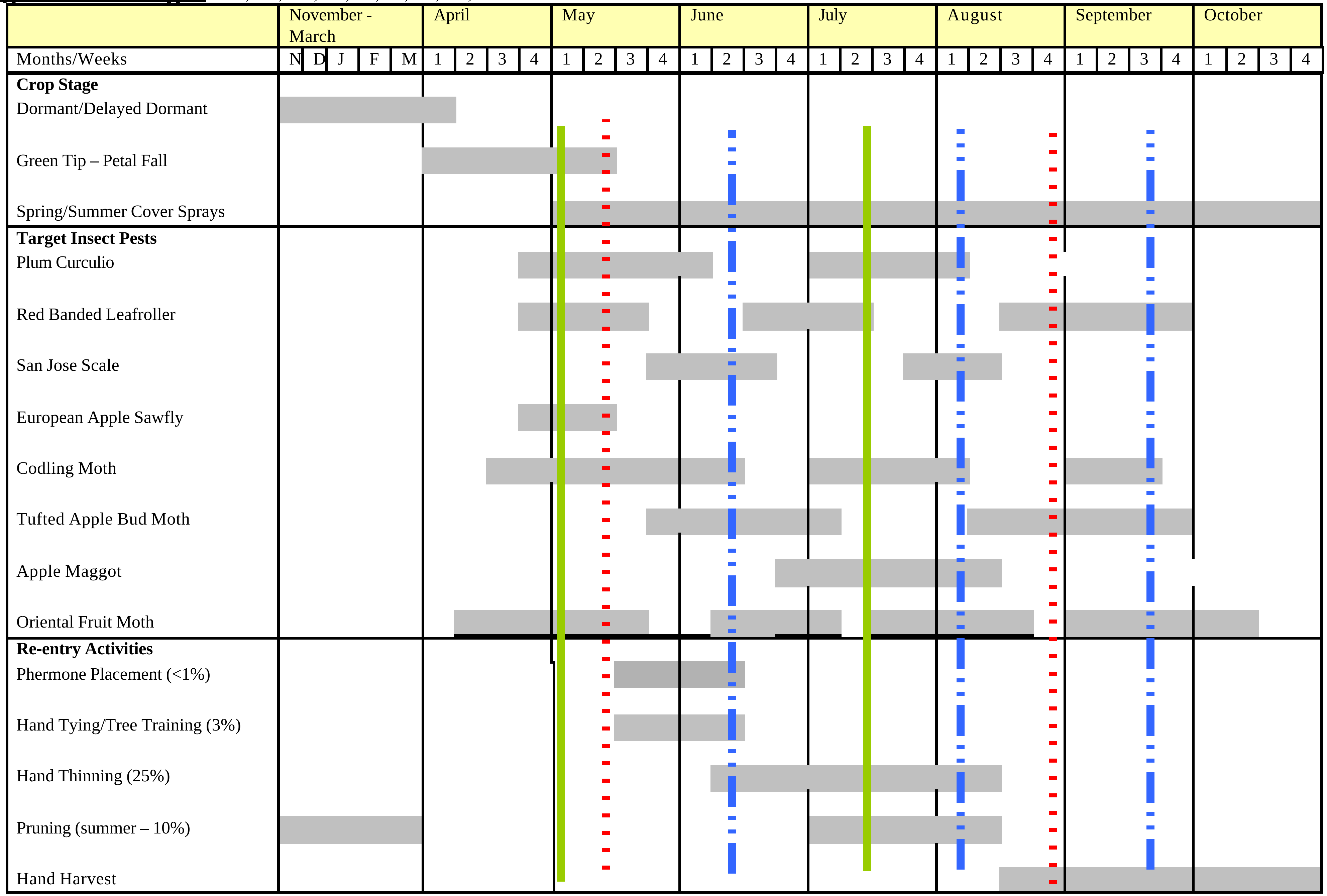
Appendix B

Apple Production Regional Timelines

Please see attached files:

- Apples_AppendixB_Appalachian_Southern_Timeline
- Apples_AppendixB_New_England_Timeline
- Apples_AppendixB_North_Central_Timeline
- Apples_AppendixB_Pacific_Northwest_Timeline
- Apples_AppendixB_Pacific_South_Timeline

Appalachian Southern Apples – DE, GA, MD, NC, PA, SC, TN, VA, WV



Key
Typical application timing for either AZM or Phosmet
AZM typical application timing
Phosmet typical application timing

Sources: US Apples Association Strategic Pest Management Plan, 4/16/2001; USDA Crop Profiles for Apples in North Carolina, West Virginia and Kentucky; 1998-1999 Pennsylvania Tree Fruit Production Guide; 1998 Georgia Pest Control Handbook; 1999 Integrated Orchard Management Guide for Commercial Apples in the Southeast, Auburn Univ., Clemson Univ., Univ. of Georgia, North Carolina State Univ., Univ. of Tennessee; Commercial Tree Fruit Spray Guide, 1999, Univ. of Kentucky; 1998 Spray Bulletin for Commercial Tree Fruit Growers, Virginia Tech, West Virginia Univ., Univ. o f Maryland

New England Apples – CT, RI, ME, MA, VT, NH, NJ, NY

Key

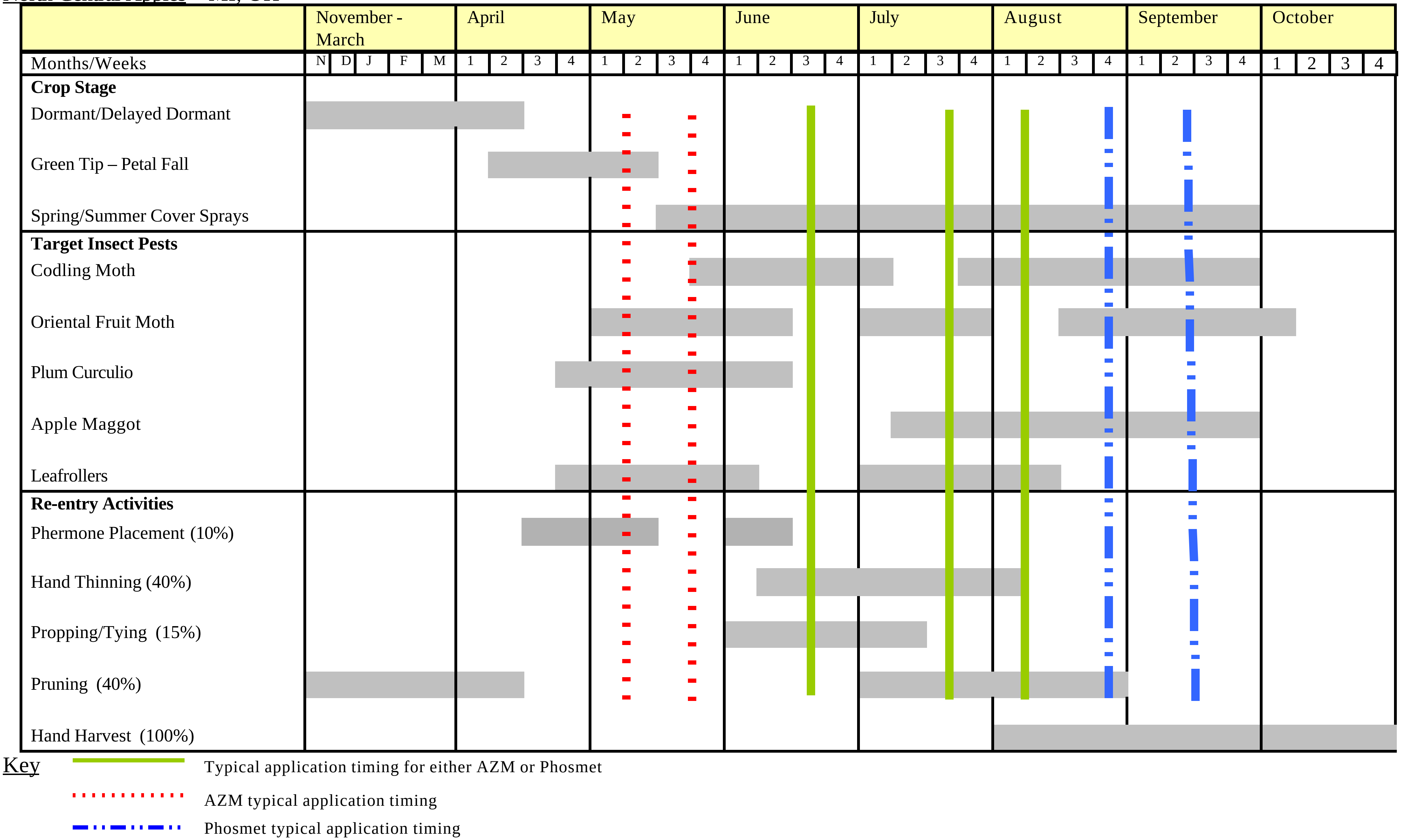
Typical application timing for either AZM or Phosmet

AZM typical application timing

Phosmet typical application timing

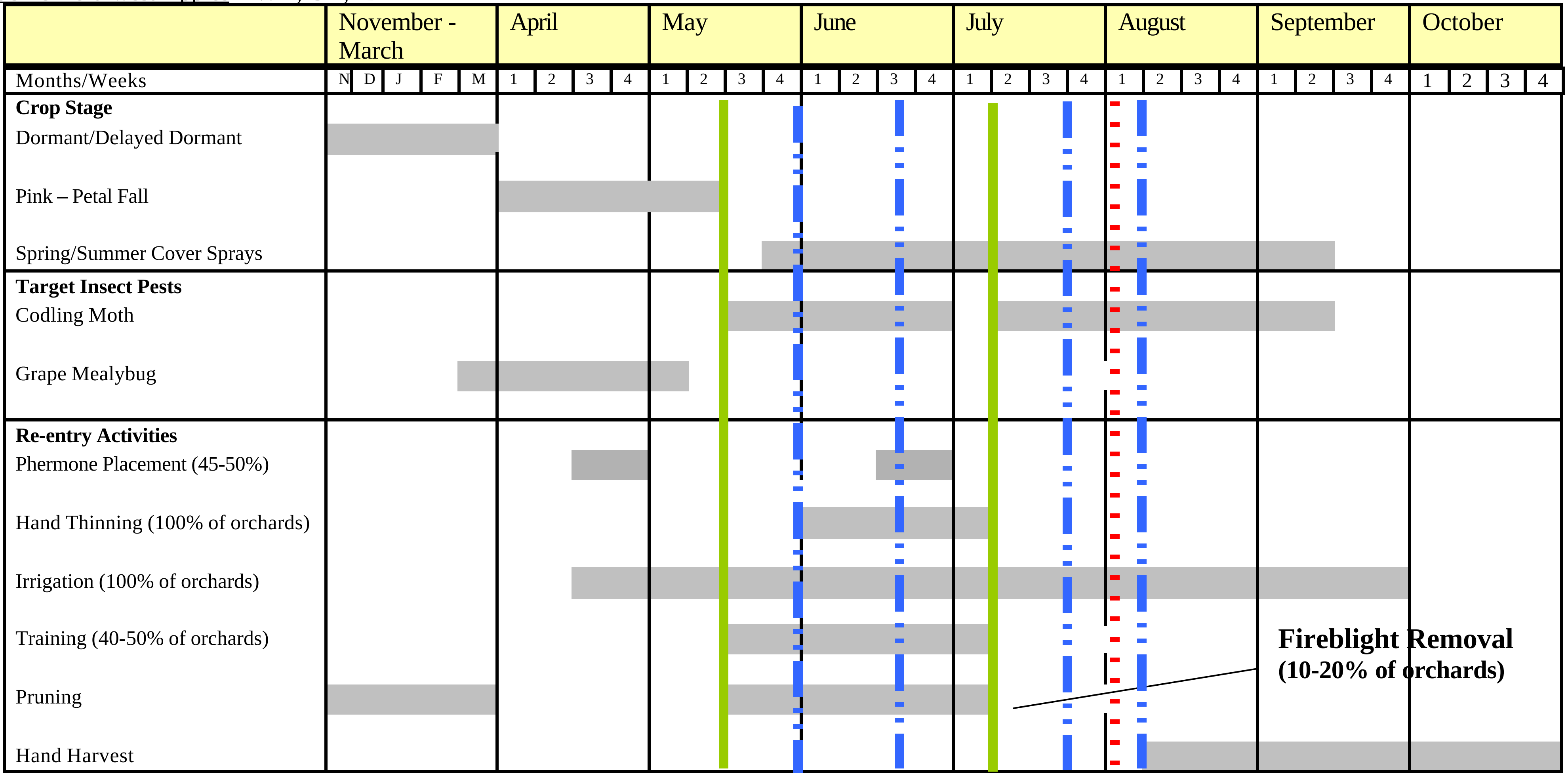
Sources: US Apples Association Strategic Pest Management Plan, 4/16/2001
USDA Crop Profile for New York Apples, 10/2000
1998-1999 New England Apple Pest Management Guide

North Central Apples – MI, OH



Sources: US Apples Association Strategic Pest Management Plan, 4/16/2001
Fruit Spraying Calendar 2001 – Michigan State University
USDA Crop Profile for Apples in Ohio

Pacific Northwest Apples – WA, OR, ID



Key

Typical application timing for either AZM or Phosmet

AZM typical application timing

Phosmet typical application timing

Sources: US Apples Association Strategic Pest Management Plan, 4/16/2001
2001 Pacific Northwest Insect Management Handbook – Washington State University, Oregon State University, University of Idaho
2001 Pest Management Guide for the Willamette Valley – Oregon State University
USDA Crop Profile for Apples in Idaho, 8/2000
USDA Crop Profile for Apples in Oregon, 12/1999
Key Sampling Periods for Major Pests of Apples – http://whatcom.wsu.edu/ag/comhort/nooksack/appleweb/sampling.html

Pacific South – CA, AZ

Key

Typical application timing for either AZM or Phosmet

AZM typical application timing

Phosmet typical application timing

Sources: US Apples Association Strategic Pest Management Plan, 4/16/2001
USDA Crop Profile for Apples in California
University of California Pest Management Guidelines: Apples, 2000
Integrated Pest Management for Apples and Pears, 2nd Edition, 1999

Appendix C

Benefits Factors and Calculations

Benefits Factors

The following is a list of the factors considered by EPA in drafting the benefits assessment for azinphos-methyl and phosmet use on apples. These factors were identified by apple industry representatives as important during meetings held between EPA and the apple industry.

Important Benefits Factors to Apple Growers

- A. Regional Differences
    - 1. Production practices
    - 2. Pests
- B. Revenue Loss
    - 1. Quality (color and size) loss
        - A. Grade decrease
    - 2. Market Destination Loss
        - A. Fresh to processed
        - B. Processed to no sale
        - C. Exports to domestic
    - 3. Yield Loss
        - A. Less tree production
        - B. Culling/sorting loss
- C. Increased Costs
    - 1. Chemical Inputs
        - A. Alternatives to azinphos-methyl and phosmet
        - B. Increased number of applications of phosmet or alternatives to azinphos-methyl and phosmet
        - C. Secondary pest control
    - 2. Culling/Sorting Costs
        - A. In the field
        - B. In the packing house
- D. Apple Enterprise Viability
    - 1. Changing Price Structure
    - 2. International Competition

Benefits Calculation

The calculation of benefits assumes a change in the revenues and costs of producing apples as a result of changing the restricted entry intervals (REIs) for azinphos-methyl and phosmet on apples. The initial calculation of the benefits assumed that data would be available, by region, on the price received and quantity produced for every grade of fresh apple produced, the price received for apples exported, the price received for apples for processing by end use market, the costs of alternative chemical controls, and the number of rejected loads and value of a rejected load. In the final analysis, many of these values are available, however, the change in values, particularly quantities, are not known for each of the variables identified in the initial equation. As a result, some of the variables were dropped in the final equation. For example, we can determine the average price and quantity of fresh apples produced by grade, but we do not have estimates of the change in quantity by grade as a result of changing the REIs for azinphos-methyl and phosmet. So, revenue by grade for the fresh market (and by end use in the processed market) was replaced by revenue for all fresh (and all processed). We can estimate changes in the total fresh and processed quantities sold from changing the REIs for azinphos-methyl and phosmet.

It was also determined, based on conversations with industry experts, that prices received for domestic and export fresh apples are very similar, so no distinction between apples destined for each market was made in the final equation. (It is also very difficult to estimate the change in quantity between end use markets. Having two (fresh and processed), rather than three (fresh, processed and export) end use markets simplifies the assumptions made.)

On the cost side, there was no data available to estimate the change in the number of rejected loads due to changing the REIs for azinphos-methyl and phosmet, so this variable was dropped from the final equation as well.

Initial Benefits Equation

$$\begin{aligned}\text{Profits}_i &= \text{revenues}_i - \text{costs}_i \\ &= [(\Sigma^{z}_{j=a}(P_{fdij}\,Q_{fdij}) + (P_{fei}\,Q_{fei}) + (\Sigma^{z}_{k=a}P_{pik}\,Q_{pik})] - [\text{ChemCost}_i + (\text{RejLoad}_i)(\text{VRejLoad}_i)]\end{aligned}$$

where i = region;

P_{fdij} = price received for fresh domestic apples in region i, of grade j,
Q_{fdij} = quantity produced of fresh domestic apples in region i, of grade j,
P_{fei} = price received for fresh export in region i,
Q_{fei} = quantity produced of fresh exported apples in region i,
P_{pik} = price received for processed apples in region i, for end use k,
Q_{pik} = quantity produced of processed apples in region i, for end use k,
ChemCost_i = increased chemical costs in region i,
RejLoad_i = number of rejected loads in region i, and
VrejLoad_i = value of a rejected load in region i.

Final Benefits Equation

$$\begin{aligned}\text{Profits}_i &= \text{revenues}_i - \text{costs}_i \\ &= [(P_{fi}\,Q_{fi}) + (P_{pi}\,Q_{pi})] - [\text{ChemCost}_i]\end{aligned}$$

where i = region,

P_{fi} = price received for fresh (domestic and export) apples in region i,
Q_{fi} = quantity produced of fresh (domestic and export) apples in region i,
P_{pi} = price received for processed apples in region i,
Q_{pi} = quantity produced of processed apples in region i,
ChemCost_i = increased chemical costs in region i.

Sources and References

US Apple Association Strategic Pest Management Plan, 4/16/2001

2001 Pacific Northwest Insect Management Handbook – Washington State University, Oregon State University, University of Idaho

2001 Pest Management Guide for the Willamette Valley – Oregon State University

USDA Crop Profile for Apples in Idaho, 8/2000

USDA Crop Profile for Apples in Oregon, 12/1999

Key Sampling Periods for Major Pests of Apples – http://whatcom.wsu.edu/ag/comhort/nooksack/appleweb/sampling.html

USDA Crop Profile for New York Apples, 10/2000

1998-1999 New England Apple Pest Management Guide

Fruit Spraying Calendar 2001 – Michigan State University

USDA Crop Profile for Apples in Ohio

USDA Crop Profile for Apples in California

University of California Pest Management Guidelines: Apples, 2000

Integrated Pest Management for Apples and Pears, 2nd Edition, 1999

USDA Crop Profiles for Apples in North Carolina, West Virginia and Kentucky

1998-1999 Pennsylvania Tree Fruit Production Guide

1998 Georgia Pest Control Handbook

1999 Integrated Orchard Management Guide for Commercial Apples in the Southeast, Auburn Univ., Clemson Univ., Univ. of Georgia, North Carolina State Univ., Univ. of Tennessee

Commercial Tree Fruit Spray Guide, 1999, Univ. of Kentucky

1998 Spray Bulletin for Commercial Tree Fruit Growers, Virginia Tech, West Virginia Univ., Univ. o f Maryland

USDA/NASS, Noncitrus Fruits and nuts 2000 Preliminary Summary, Jan. 2001.

USDA/NASS Agricultural Chemical Usage: Fruit and Nut Summary , 1997 and 1999.